modern machine shop

OCTOBER 1961

NUMERICAL CONTROL IN OPERATION

See Page 114

MACHINING SMALL GEARS See Page 134

The MAGAZINE for PRODUCTION EXECUTIVES in METALWORKING PLANTS



RO
UNIVERSAL
FORM RELIEVING
EQUIPMENT

FIXTURE GRINDER COMPARATOR More than 300 owners of R-O equipment have sent operators to take the R-O training course and report that men return with a new appreciation for the potentials of the equipment—better able to recognize other jobs, too, that can be done better, easier and faster.

See page 97



A NEW TOOL-SETTING **METHOD**

> Tool-Tronic Gage locates tool tip within .000025 by fast, simple electronic-optical method

by Alden H. Jacobson, Chief Engineer Bore-Matic Division The Heald Machine Company

With today's trend to greater accuracy and precision in single-point Borizing, the problem of precise tool-tip location becomes

increasingly important.

Previous methods, while of high accuracy, are relatively slow and require considerable skill on the part of the operator. The optical method, using a precision-calibrated microscope, is dependent on the relative degree of operator eye fatigue. If eyestrain is a result, such an undesirable condition is known as "eyeballing." And the touch method, using dial indicators, often causes microscopic damage to the cutting edge with resulting impairment of the finished surface.

Here at Heald we have devoted a great deal of research to devise a method of toolsetting which would maintain the highest accuracy, prevent tool tip damage, and require no special operator skill.

The result is the new Tool-Tronic Gage illustrated here. Tool tip location is precisely determined by optical means, with electronic amplification giving highly accurate readings on two large meter scales.

The unit consists essentially of a sensing head which contains the light source, optics and photo cells, and a separately mounted amplifier and meter case. The sensing head is mounted vertically on the machine near the workhead, where the tool can be positioned into gage opening. As the tool is moved into place by operation of the table and cross slide, it interrupts the light rays and the amount of light passing on each side of the tool is compared to reference

photocells and read out on two large horizontal-scale me-

Tool-Tronic Gage, showing meter case, sens-ing head and cable. To locate the tool with an accuracy of 25 millionths, it is only necessary to move tool in X and Y directions until the pointers on both meters are centered on the "zero" mark. For the operator to determine this precise position and return to it whenever desired requires no more skill or experience than that needed to operate the machine.

The Tool-Tronic Gage can be used with most types of single-point boring and turning machines. It should prove especially valuable on numerically-controlled contour Borizing equipment where extreme precision is required.

Your Heald engineer will be glad to arrange a demonstration of this new tool setting gage for you, in your plant or ours.



Tool-Tronic gage in use on a numerically-controlled Heald Model "S" Bore-Matic. Sensing head (arrow) receives tool and centering indication is read on meters at right.

It PAYS to come to Heald

MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co. WORCESTER 6, MASSACHUSETTS

For more data circle 302 on Postpaid Card



Fred W. Vogel, Editor
Robert I. Shore, Managing Editor
K. M. Gettelman, Associate Editor
M. C. Due, Editorial Assistant
Gilbert C. Close, Field Editor
Alfred M. Cooper, Consulting Editor
Howard Campbell, Editor Emeritus
Norman S. Rogers, Art Editor
J. G. Apke, Director of Reader Services
M. L. Forney, Publisher
Richard S. Kline, General Manager

modern machine shop

For Production Executives

Vol. 34, No. 5, October, 1961

contents

Numerical Control	Interview with an N/C Job Shop General Manager114
Forming	Propellant Cases Produced by Ardeform Process124
Trade Show	The 1961 Detroit Metal Show
Quality Control	Machining Small Gears to Precision Tolerances134 By Winfred M. Berg
Die Design	Two-Station Die Forms Special Channels142 By Roger Isetts
Numerical Control	Let's Discuss Numerical Control146 By K. M. Gettelman
Deburring	Automatic Machine Deburrs Tube Ends154
Welding	Improving Weld Quality on Motor Switch Parts 156
Chilling	Chilling Machine Tests Automotive Parts158
Inspection	Production Checking of Gear and Spline Leads160
Dust Control	Standard System Solves Grinding Dust Problems162
Metallizing	Metallized Truck Hubs Outlast Original Parts164
Sawing	Jeweler's Saw Cuts Thin Walled Tubing166 By Gilbert C. Close
Tool Design	Tool for Removing Bushings
Drilling	Submerged Drilling Improves Hole Finish

departments

Market, of the Market Market State of the St		
Important Meeting Dates 64	Ideas from Readers	NED
Advertising Representatives 101	Free Literature	The same
Over the Editor's Desk102	News of the Industry	MEMBER (B
Report from Washington106	New Equipment	
Supervisory Problems	Where to Get It	FIELD
More Production	Advertisers in This Issue	BPA

A STATEMENT OF POLICY—The principal function of MODERN MACHINE SHOP is to search out and disseminate the best and newest ideas for advancement of engineering skill and mechanical efficiency in the metalworking industry and neither effort nor expense is spared in the performance of this task.



page

JOB SHOP GENERAL MANAGER

Successful operation of a job shop equipped with numerically controlled machine tools is being done by Numerical Machining Inc., Cleveland, Ohio. NuMac, as it is referred to, is managed by President C. R. Swetel and General Manager Richard Stitt. At NuMac the editors of MMS were shown some interesting machining jobs and some revealing insights into the operating methods and management philosophies which guide this organization.



▶ 124 SOLID PROPELLANT CASES PRODUCED BY ARDEFORM PROCESS

A variety of workpieces including solid propellant rocket engine cases and helium storage spheres for satellites may now be simultaneously stretched and strengthened by means of a process known as Ardeform which has been introduced by Arde-Portland, Inc. of Paramus, New Jersey. Developed primarily for the fabrication of large, high strength, solid propellant rocket cases, the Ardeform process is also expected to find application in the fabrication of thin-walled pressure vessels, mobile cryogenic storage containers, and high strength tubing.

▶ 128 THE 1961 DETROIT METAL SHOW

Latest advances in engineering materials and materials processing will be reported in 68 half-day sessions of the 1961 Detroit Metal Show, October 23-27 in the Motor City's beautiful new Cobo Hall. Outstanding speakers have been programmed from many parts of the United States and Canada, representing leading industries and research laboratories. Everything from metal producing to atomic energy will be covered in more than 200 papers.

n@hls issue

page

134 MACHINING SMALL GEARS TO PRECISION TOLERANCES

By Winfred M. Berg

The need for extreme accuracy in electro-mechanical systems which control and operate many of today's advanced computers, servo systems, space vehicles, airborne instruments, military equipment and industrial processes, has created an urgent demand for precise mechanical components. Only a few short years ago, such basic components as spur gears could not be obtained with less than



0.006 inch composite error except by cutting many gears and selecting those within tolerances. Today, precision-instrument gears are mass-produced with a maximum total composite error of 0.00025 inch. This is accomplished largely by extra steps to insure precision and by a quality control system pertaining to all phases of gear manufacture.

142 TWO-STATION DIE FORMS SPECIAL CHANNELS

By Roger Isetts

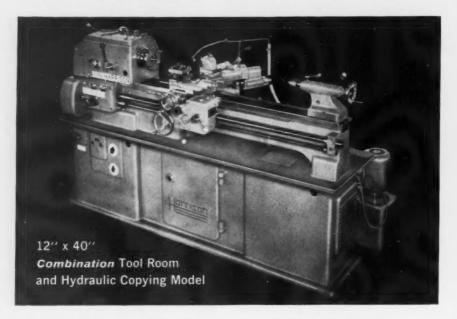
Illustrated and described in this article is a die that was designed to produce an overbent channel in one press stroke. The part was made of 18 gauge cold rolled steel and had two different size legs.

146 LET'S DISCUSS NUMERICAL CONTROL

By K. M. Gettelman

Four classifications of numerically controlled machine tools have been established by the Aerospace Industries Association. A description of these classifications and terms involved in discussing them are the subject material of the second in the Numerical Control series which is designed to familiarize the reader with this vital new force in the metalworking arts today.

HARRISON PRECISION ALL-GEARED HEAD LATHES



THINK OF IT: You can buy a fine Combination Tool Room and Hydraulic Tracer Lathe for what you'd expect to pay for a single purpose lathe! Available without the Tracer for even less!

MODERNIZE with HARRISON Lathes. A remarkable combination of Guts and Precision at amazingly low prices. Available in 11", 12", 13" and 16" sizes. We can't tell the whole story here. Send for literature.

YOUR BEST BUY - HERE'S WHY!

- · All-geared heads with clutch and brake drive
- · Chrome-Nickel Steel heat-treated shaved gears
- Induction Hardened Heavy Beds
- Precision Timken Bearing Spindles with American Standard Taper-Key Noses
- Lead Screw and Feed Rod construction, with Safety Slipping Clutch (no shear pins)
- Heavy Aprons Lever Clamping Tailstocks
- · Heavy duty motor drives, magnetic controls
- Broad Speed Range easily selected
- Clean-cut modern design Pleasing to the eye
 Pleasing to the Operator

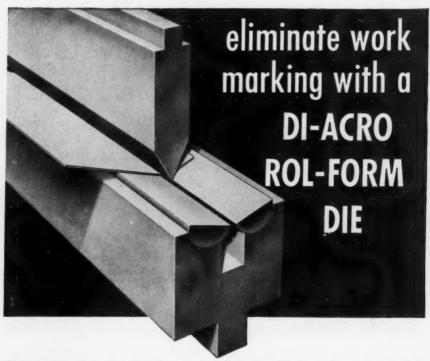
National Distributor: REM SALES, INCORPORATED

A SUBSIDIARY OF THE ROBERT E. MORRIS COMPANY — WEST HARTFORD 7, CONN.
Sales and Service Representatives in all principal industrial areas

For more data circle 311 on Postpaid Card

MODERN MACHINE SHOP

October, 1961



Workmarking from forming sheet materials in press brakes and punch presses is greatly reduced and in many metals completely eliminated when formed with the Di-Acro Rol-Form Die. Hardened and Precision ground rolls pivot smoothly in the die block to fold material without strain. You save costs by discarding elaborate and time consuming preparation and work methods, reducing polishing time, eliminating scrap parts. You also cut costs in press brakes and punch presses by reducing the number of dies needed and reducing set-up time.

One Di-Acro Rol-Form Die with a 60° upper die forms any angle to 60° and any thickness of metal to $\frac{1}{8}$ " just by adjusting the ram or bed of the brake. Where ultra-high finish material is to be formed, nylon inserts can be used in the die block to further reduce the possibility of work marks.

The Rol-Form Die is offered in five styles and in lengths from 6 inches to 12 feet for use in all sizes and models of press brakes and punch presses.

For ordinary press brake forming ask about Di-Acro Standard Press Brake Dies.





Consult the yellow pages of your telephone book under Machinery-Machine Tools for the name of your nearest Di-Acro distributor or write us.

DI-ACRO CORPORATION

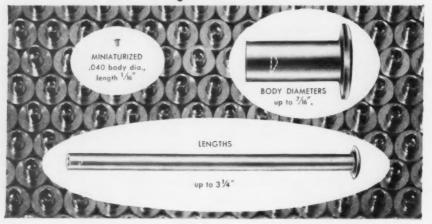
pronounced die-ack-ro

formerly O'Neil-Irwin Mfg. Co. 7510 Eighth Avenue • Lake City

Lake City, Minnesota

For more data circle 312 on Postpaid Card

Look at this Size Range of Semi-Tubular Rivets... its the way to lower cost



Miniaturized components and also large complete assemblies can now have all the money-saving advantages of using single and multiple automatic riveting. This is due to the wider size range of semitubular rivets now available and which can be used in conjunction with motor and pneumatic driven automatic riveting machines.

Today, there is hardly a fastening problem, involving even fragile materials, that does not warrant consideration of low-cost semitubular rivet setting.

Our Factory Riveting Specialists are ready to help you obtain the REAL COST FACTS on your own specific fastening problem. There is no obligation.



FOR YOUR FILES

Chicago Rivet Catalog describes 1388 standard tubular and split rivets and 25 single and multiple automatic rivet setters.



AIR-POWERED RIVETING

contains description and specifications of B single, multiple riveters—also rivet setters designed for automated operation.

Chicago Rivet & MACHINE CO.

963 So. 25th Ave., Bellwood, III. (Chicago Suburb) Branch Factory: Tyrone, Pa.

For more data circle 313 on Postpaid Card

All around your shop ...



Precision finishing or light roughing



General purpose machining

16 V-R carbide grades give complete machining flexibility

Each V-R carbide grade is created with its own special combination of hardness, toughness and heat resistance. Sixteen such individual grades, plus a ceramic grade, bring you complete machining flexibility. You'll find the exact combination of tooling characteristics for your job regardless of the operation to be performed or the material to be machined. V-R's rigid quality control assures you of the same consistent, superior performance every time. Ask your V-R man to help you select the V-R cutting tool that's best for your job.

Vascoloy-Ramet Corporation 894 Market Street, Waukegan, Illinois



Heavy-duty roughing or interrupted cuts



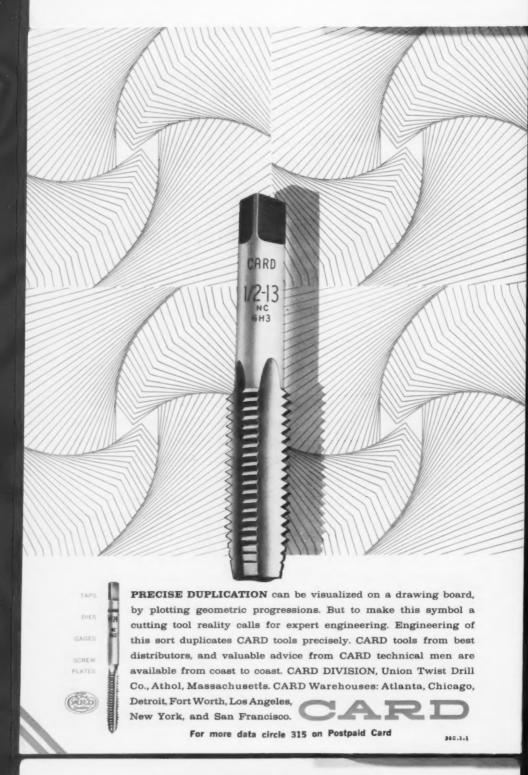
FIRST CHOICE in more and more plants

For more data circle 314 on Postpaid Card

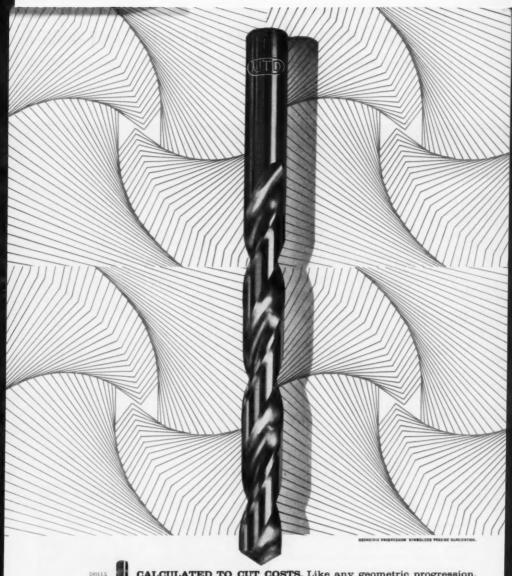
October, 1961

MODERN MACHINE SHOP

7



Twelve linear feet of parts every minute



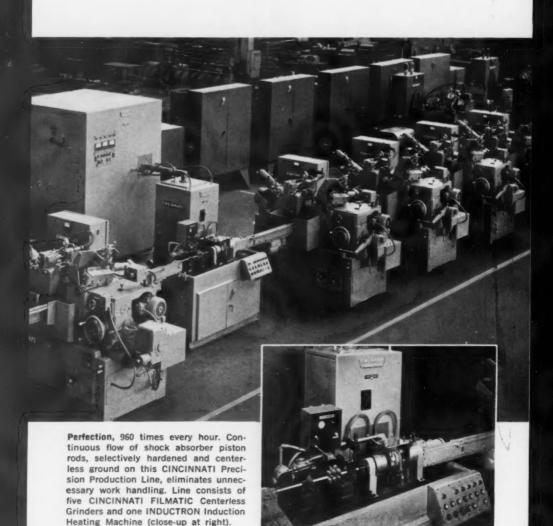
DRILLS
REAMERS
MILLING
CUTTERS
END MILLS
GEAR CUTTERS
HOBS
CARBIDE TOOLS
INSERTED BLADE
CUTTERS

CALCULATED TO CUT COSTS. Like any geometric progression, UNION cutting tools create a pattern of precise duplication... providing identical dimensions in each type and size, and identical performance on each job. That is why they are calculated to keep your production high, your costs low. UNION distributors and technical service are available nationally. Fully stocked UNION warehouses in Atlanta, Chicago, Detroit, Fort Worth, Los Angeles, New York, San Francisco, UNION TWIST DRILL COMPANY, Athol, Massachusetts. Card Division, Athol, Mass., Butterfield Div., Derby Line, Vt.

For more data circle 316 on Postpaid Card

36.1.1

Twelve linear feet of parts every minute



CINCINNATI MILLING MACHINE CO., CINCINNATI

hardened and ground on CINCINNATI Production Line





Shortest and fastest trip to the point of perfection ... the one taken by shock absorber piston rods in this cincinnati Precision Production Line. From the loading unit at the extreme left work traverses first through a cincinnati filmatic Centerless Grinder for the primary grinding operation, then through an induction Heating Machine for hardening of the center section. Four more Centerless Grinders complete the grinding operation, the finished parts emerging at a rate of 12 linear feet per minute or 960 per hour.

CINCINNATI FILMATIC Centerless Grinders are ideal for production line duty. Infinitely variable regulating wheel speeds permit close adjustment of speed to suit station-to-station work traverse. Simple swivel plate adjustment aligns work rest and regulating wheel unit with conveyor. FILMATIC grinding wheel spindle bearings will never stop production. Many other feature-advantages are outlined in Catalog G-727-1D, covering the Centuramic line of centerless grinders. May we send you a copy? Grinding Machine Division, The Cincinnati Milling Machine Co., Cincinnati 9, Ohio.

HUCKING . MICRO-CENTRIC . PRODUCTION LINES



For more data circle 317 on Postpaid Card

if you're thinking of using the newest screw-type fasteners...

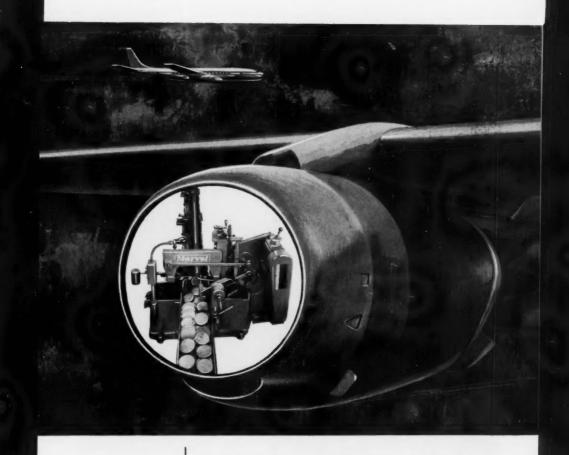
	HEX	SIZE	TO BE U	ED IN		
TYPE OF SHANK	Naminal	Actual	Socket Nead Cap Screw	Socket Set Screw	Overall Length	Pert Number
1/4" HEXAGON DRIVE	1/16	.062	#1	5 & 6	1-15/16	AM-02
1/4 HEARDON VIII.	5/64	.077	#2, #3	8	1-15/16	AM-02
	3/32	.092	14,#5, #6	#10	1-15/16	AM-03
	7/64	.108	#6	-	1-15/16	AM-03
-	1/8	.124	#8	1/4	1-15/16	AM-04
	9/64	.139	8.8		1-15/16	AM-04
	5/32	.155	#10	5/16	1-15/16	AM-05
Insert and powe	r bits to dri	ve the	new 7/64	1" and	9/64"	AM-06
hex sizes have	been added	to th	e comple	ete rar	oge of	AM-07
Apex tools to dr	ive socket	head s	crowe 1	/16" +-	E/0"	AM-08
hex sizes.	000	iicad 3	ciews, 1	10 10	3/0	A5-04
3/16 170% 512051	5/32	1 .155	I #10 I	5/16	T 3	AS-05
	3/5%	104	1/4	. 3/8	3	A\$-06
	722	-			~	-
	1/4	.249		1/2	3-1/2	AN-UN
the tool	O MOIN	/III	boo	40	duis	1-10
LHC LOOK	5 you	11 11	leeu	LU	ULIA	C 1-12
	800					1-16
				-		-08
	alre	adv	in s	toc	k—	
them are	alrea	ady	in s	toc	k—	-10

Consistent states shaken in John are new 1960 standards climension.

If you're driving thousands of screws a day, or just a few . . . if you use several types and sizes of screws or just one . . . Apex has the screwdriving tools to help you save time and money. All standard types and sizes in stock . . . specials get "special" attention! For complete information, write for your copy of the new Catalog 30-C.



For more data circle 318 on Postpaid Card



TOO SLOW ?

Emphatically not! . . . ask any visitor to the 1960 Machine Tool Exposition who watched a Marvel No. 6 Hack Saw Machine cut-off 3½" diameter 1018 steel in 27 seconds! This Saw, costing less than \$3000, was actually cutting at the rate of 18 square inches per minute!

We made the above demonstration merely to "match" what we believe to be the impractical demonstrations of some of our competitors. OUR visitors were warned that continuous cutting at this speed is economically impractical if maximum blade life and accuracy (after the first 20 cuts) are desired. They were told that the material could be cut day in and day out, at the rate of 8 square inches per minute with tool cost of approximately 1 cent per cut.

Our point? Marvel No. 6 and No. 9 Series Heavy Duty Ball Bearing Hack Saw Machines, as we build them today, have <u>speed to spare</u>. And they offer the most accurate, economical cut-off at the lowest initial investment.

Ask your Marvel Dealer to arrange a sawing demonstration—on your own work—if you wish. Because we have consistently built both Hack Saws and Band Saws for more than 40 years, you will get an unbiased recommendation.

Catalog C60 illustrates and describes the complete line of Marvel Sawing Machines. Write for your copy.

MARVEL Metal Catting SAWS

BETTER MACHINES
BETTER BLADES

ARMSTRONG-BLUM MANUFACTURING CO. • 5700 Bloomingdale Avenue • Chicago 39, Illinois
For more data circle 319 on Postpaid Card







Robbins Angular Tooling Saves Time...

IN GRINDING Single or compound angles set up in seconds with this Robbins Magna-Sine. Available in a range of sizes, Magna-Sines double as "everyday" magnetic chucks for all surface grinding jobs, or can be used off the machines for bench work.

IN MACHINING Heavy-duty 12" x 12" or 24" x 24" Sine Plates permit safe, accurate angular machining without V-blocks or angle plates. Non-magnetic top plate has tapped holes and T-slots. Special construction resists stress of boring and milling.

IN INSPECTION Four quick steps to easy setups: 1. Check Table of Constants for standard gage block needed for proper angle. 2. Select gage block. 3. Insert gage block and lock top plate. 4. Position work. Versatile 4" x 4" model shown here is also available as magnetic Magna-Sine.

Robbins Angular Tooling features hardened and ground alloy-steel work and bearing surfaces, distortion-free ribbed bases, positive locking, and, in Magna-Sine models, the most powerful ceramic permanent magnet ever built.

See your Robbins Representative, or write for prices and specifications of the complete line.

A1.18

EX-CELL-O FOR PRECISION

Perception material Profit is immunity and entired symbolic stort and fact to August Angules and Recoposition to Source on the manufacture of the August Angules and August Angules an EX-CELL-O

For more data circle 320 on Postpaid Card



ON A GISHOLT AUTOMATIC RAM



Gisholt MASTERLINE AR Turret Lathe

From bar to chucking in less than an hour. Sets up like a turret lathe, uses same standard tools. Cycle setting learned in a day.

Automatic drill withdrawal for chip clearing Internal threading with solid taps.

External threading with self-opening die heads. Reverse feed and individually adjustable dwell. 16 spindle speeds and infinite feeds—none

lost when threading.

Ask your Gisholt Representative for a desk-side demonstration, or write for Catalog 1224.

Are you keeping step with new developments in automatic machining? Many of your competitors are—and cutting costs substantially. Even small runs—both bar and chucking work—are now going automatic. How? With the new, fast, easy setup designed into the Gisholt AR (Automatic Ram) Turret Lathe. Change-over time is the same as for a hand-operated machine. And—the automatic cycle cuts machining costs 25% to 40%.

To be competitive you must go automatic. Why wait? Investigate the Gisholt AR—your best answer to the cost profit squeeze.



Turret Lathes - Automatic Lathes - Balancers - Superfinishers - Threading Lathes - Factory-Rebuilt Machines with New-Machine Guarantee

For more data circle 321 on Postpaid Card

you are gaging precision holes note the advantages of the

E-X-P-A-N-D-I-N-G

UG GAGE

- 2-POINT CONTACT, automatically and positively assured. This means you can read the exact diameter at any point, detecting front or back taper, ovality, bell mouth, etc.
- AUTOMATIC POSITIONING. The alignment and centering are automatic, and the gaging pressure is automatically uniform. This means that you can put Comtorplug into the hands of any operator, with a few minutes' instruction, and get accurate gaging as well as repeatable duplication person-to-person.
- PRECISION ASSURED. The dial reading is fixed not passing - easily readable within .0001". (See actual size illustration at right.) This means your operator reads the exact size, no "guesstimating". Comtorplug gives exactly what is needed for Statistical Quality Control programs.

No other Gage like it!

These basic advantages tell you why Comtorplug stands out as a gage of ASSURED PRECISION and EASE OF APPLICATION. Used by the thousands on automotive transmission, electrical equipment, high speed machinery, anti-friction bearing housings, household equipment and similar volume-precision operations. Let us send you the facts.

REQUEST BULLETIN 51 COMTOR CO. 64 FARWELL STREET

WALTHAM 54, MASS

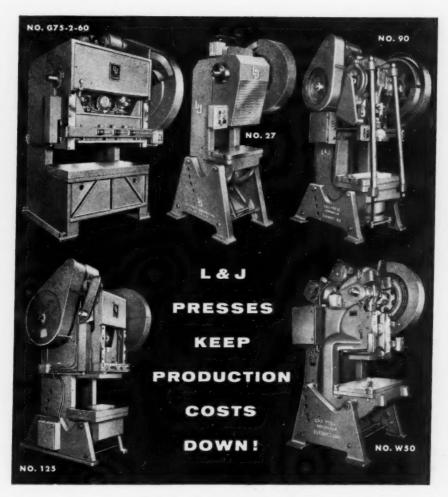
COMTORPLUG

E-X-P-A-N-D-I-N-G PLUG GAGE FOR HOLES 1/8" to 10" DIAMETER

For more data circle 322 on Postpaid Card



ACTUAL SIZE





There's a good reason why L & J Presses can do this—they are engineered for it. Each year sees new techniques in metalworking, and each year sees more improvements in L & J Presses to match them to user's requirements. Advancements in basic design, metallurgy, components and controls continue to provide the increased efficiency and dependability needed to keep metalworking costs down.

Write for L & J catalog of O.B.I., Straight Side and Gap Frame Presses—you should know how much more they now offer.

L&J PRESS CORPORATION, 1624 STERLING AVE., ELKHART, IND.

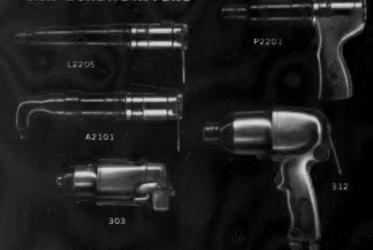
For more data circle 323 on Postpaid Card

October, 1961

MODERN MACHINE SHOP

16a

AIR SCREWDRIVERS



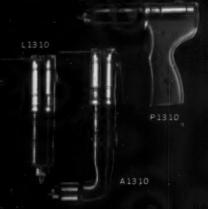
New tools! Improved designs! same..



AIR NUT RUNNERS







dependability!

Handles, air motors, gears (rpm), chucks, and clutches of the new SIOUX P, A, L prefixed drills, screwdrivers, and nut runners are interchangeable. Any one of a possible 1,000 combinations is available to precisely meet the needs of each job. Disassembly for service or conversion to another job is equally easy.

Air and oil exhausts from the base of the handle through a remote exhaust hose or deflecting silencer so that it can not be blown on the work.

Whether it's an electric drill, screwdriver, air impact screwdriver or one of the new P, A, L series, expect stamina, power, smooth performance, and ease of operation from the SIOUX family of fine tools. Ask for a demonstration!

ELECTRIC SCREWDRIVERS





ALBERTSON & CO., INC.

SIOUX CITY, IOWA, U.S.A.

FIND YOUR NEAREST U.S. DISTRIBUTOR UNDER "TOOLS, ELECTRIC" IN THE YELLOW PAGES.

▲ AIR & ELECTRIC IMPACT WRENCHES • DRILLS • SCREWDRIVERS • NUT RUNNERS • SANDERS • GRINDERS ▲ ELECTRIC POLISHERS • FLEXIBLE SHAFTS • PORTABLE SAWS • VALVE GRINDING MACHINES ▲ ABRASIVE DISCS



Band Saw Machine Tool

One MILBAND Machine Replaced two other cutting machines at Frink Sno-Plow Plant

In 1959, a MILBAND Machine was installed to do the work of two other cutting machines. When the MILBAND was destroyed in a disastrous fire in September, 1960, Frink Sno-Plow insisted that another MILBAND Machine be rushed to the plant.

"It was a question of rebuilding production schedules fast to survive," said Shop Foreman Richard S. McAllister. Advantages of the automatic MILBAND Machine Tool noted by Mr. McAllister were, "cost per cut down appreciably ... increased production ... ease of operation." An important feature of the MILBAND that makes it especially applicable to the Frink operation is its ability to handle a wide variety of tough cut-off jobs. Users also find that the MILFORD REZISTOR High Speed Steel Blade in combination with the MILBAND is ideal for

maximum blade life and cutting accuracy. The reason is superior Blade Control Engineering at every critical point of the MILBAND...only 30° blade twist, large 22" blade wheels and 15½" pivot span, rugged construction... to eliminate destructive vibrations.

Demonstrations are easily arranged. Write us for the name of the MILBAND dealer nearest you . . . and for this free circular explaining all the cost-cutting facts about the MILBAND Machine Tool.

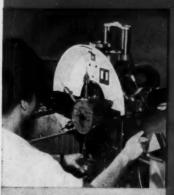
THE HENRY G. THOMPSON & SON CO. Chapel & Will Streets, New Haven 5, Connecticut Saw Specialists for 85 Years

For more data circle 325 on Postpaid Card

16d MODERN MACHINE SHOP

October, 1961

Burgmaster BENCH MODEL



JOB FACTS

Company: Prest-O-Matic Company

Machine:
Burgmaster Bench Model
Turret Drill

Part: Die Cast Aluminum Valve Body

Continuous — 220 per day

Holding: Special Fixture

Special Attachments: 2 Burgmaster "3000" Tapping Heads

Production Rate:

Former Method: 4 Single Spindle Drills

Former Production:
Valve Bodies — drill 8 —
tap 3 holes — 100 per day

Present Method:
Burgmaster Bench Model
Turret Drill

Present Production:
Valve Bodies — drill 8 —
tap 3 holes — 220 per day

Production Increase:

Other Advantages:
Less handling time, less
operator fatigue, 75% less
floor space

TURRET DRILL

Saves 89% of Equipment Cost... Increases Production 120% for Prest-o-matic

Pays for itself in Four Weeks-Saves Handling Time, Operator Fatigue and Valuable Floor Space



When the Prest-O-Matic Company, Santa Ana, California tooled up to drill 8 holes and tap 3 in their die-cast aluminum valve bodies, they selected a Burgmaster Bench Model Turret Drill to save 89% of original equipment cost, and increase production 120% over the output of 4 single spindle drill machines. Savings in production costs paid for the Burgmaster Bench Model in just 4 weeks of operation. Additional savings reported by Prest-O-Matic include less handling time, less operator fatigue, and a 75% saving in floor space.

Send for Literature



BURGMASTER CORPORATION

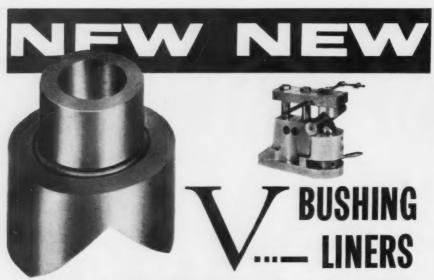
Small Tool Div., Burg Tool Manufacturing Co., Inc. 13226 S. Figueroa St., Box 311, Gardena, Calif. Phone: FAculty 1-3510 Phone, wire or write Dept.O.A.

For more data circle 326 on Postpaid Card

October, 1961

MODERN MACHINE SHOP

17



To self center cylindrical, square or hex stock for drilling

V for victory over a previously ticklish drilling job . . . new hardened ground Acme Industrial V bushing liners clamp over cylindrical (round bars, tubing, etc.), square or hex stocks . . . instantly, automatically locate dead center. Layout, jig boring eliminated . . . just center punch, drill and ream hole! Acting as a liner for removable bushings, Acme's "V" assures precision centered drilling always.

Available in 2 sets of 3 V bushing liners to accommodate slip bushings with O.D.'s of 3/16", 5/16" and 1/2" in a range from No. 80 drill to 11/32" in A.S.A. or Acme standard sizes. Acme V bushing liners . . . a must for every tool box.

ACME INDUSTRIAL COMPANY 200 North Laflin Street/Chicago 7, Illinois				
	Send me complete information on new V bushing liners Send me the complete Acme Industrial bushings catalog			
Name				
Firm				
Address				
City	State			

For more data circle 327 on Postpaid Card

Landis 18" hydraulic face grinder powered for fast stock removal...heavy cuts-fine finishes

- * fastest method of squaring up faces
- takes deep cuts-up to ¼" per pass on cast iron
- easy, faster setup
- simple operation
- saves time and costs





How to save money and make money with modern metallizing

With today's improved metallizing materials and methods:

PLANT EXECUTIVES find new ways to slash maintenance costs, reduce downtime, cut machine parts inventory...

JOB SHOP OPERATORS find new ways to build highly profitable business doing parts-salvage and maintenance work for plants in their area.

JOB SHOPS make good money with metallizing because they save good money for local firms.

Metro has prepared a special bulletin detailing actual operations and costs of typical flame spraying work on shafts, templates, bearings, many other surfaces. Use coupon to get your free copy.

NEW! Business-building kit for job shops, to help Merco equipment owners build new business, pay off investment in minimum time, and use flame spraying to increase other machining and welding business. Contains samples of direct mail letters, post cards, envelope stuffers, photos, advertising mats. These promotion materials are available in lots of 100 at our cost, well below what you'd have to pay to print your own. One copy of kit available free—send for it today. (See coupon.)

These real-life examples show how plants save money, job shops make money with metallizing

Necks of winding rolls in a textile mill were formerly repaired by a slow machining method, requiring highly skilled labor. Now the worn necks are built up with flame sprayed metal, quickly machined to size. Savings run \$20,000 a year.

A job shop in California specializes in flame spraying oil well pump plungers, gets all the business it can handle in spite of the fact that the plungers it hard-faces last eight times as long as new ones. The largest ones cost only \$45.00 to rebuild, against \$110 to replace. Volume on just this one profitable metallizing service: \$35,000 a year.

Valve plugs and seats, working in sand, oil and salt water, lasted only a few hours in service. Hard-faced by welding, a set cost \$155, lasted from 3 to 8 hours. When flame sprayed with tungsten carbide powder, service life was increased to a minimum of 2 weeks, 4100% longer! Cost of metallized set, \$73. But reduced downtime far outweighs the dollar sayings.

A Connecticut job shop makes a very good profit when it flame sprays small







Any good mechanic can quickly master the three basic steps of metallizing: 1. prepare the surface; 2. flame spray; 3. finish.

shafts for \$27.50. The customer is happy, too—he formerly had to pay over \$50 to have shafts built up with welding.

The same job shop salvaged a big degreasing tank, value \$2,850, by flame spraying with zinc for \$683. The shop made money, the customer saved money.

A shipbuilding company installed metallizing equipment to repair such parts as pump rods, pistons, crank shafts for diesel engines, stern bushings, valve stems. A badly worn tugboat shaft, replacement cost \$3,000, was repaired and made better than new for \$400. That job alone more than paid for the Metco equipment.

From these cases you can see how modern metallizing pays, whether in plant maintenance departments or in job shops serving the many companies that don't need their own installation. Wherever there's wear, in rotary or sliding action, there's an opportunity to save money and make money.

New and improved materials

Among these new materials are a number of nickel, chrome, boron hard facing powders. Sprayed tungsten carbides are also widely used. Many others are available to give new values to the basic benefits of metallizing, which may be summarized as: less downtime; far less machining or grinding time, reduced parts inventory; and "better than new" performance of the metallized parts.

With savings like these there is plenty of leeway for good job shop profits and big savings for manufacturing plants. To learn more about these opportunities, check the coupon and send it off today.



METCOINC.
FORMERLY METALLIZING ENGINEERING CO., INC.
Flame Spray Equipment and Supplies

1177 Prospect Avenue, Westbury, L. I. New York Telephone: Edgewood 4-1300 Cable: METCO. In Great Britain: METCO, Ltd.. Chobham-near-Woking. England

JOB SHOPS ONLY	PLANT MANAGEMENT			
Send Bulletin 14, "How Job Shops Make Money With Metallizing" Send Business-Building Kit Metallizing Have Field Engineer Call	How to SAVE MONEY ond cut downtime with Metallizing Send copy of Bullet "How to Save Money of Downtime with Metall Have Field Engineer C	and Cu izing"		
Name	Title			
Company				
Address				
City	Zone State			



Harig

The most complete source for

* CARBIDE DIES * STEEL DIES

BEFORE YOU RE-TOOL, we strongly urge you to make use of our Customer Consulting Service for recommendations as to what type of die would be best for your application. A typical example is the way more and more manufacturers are turning to Harig Carbide Dies because of the tremendous cost-saving advantages resulting from less downtime—longer runs—lower maintenance.

Harig's many years of experience and know-how in engineering and building dies is at your service—from the simplest to the most complicated designs, of carbide or steel. Phone or write us today and a Harig engineer will be happy to call at your plant, at your convenience.

NEW HARIG BROCHURE

... loaded with information on Harig carbide and steel dies, photos of plant facilities, charts, etc.



JUST WRITE, "SEND HARIG BROCHURE" ON YOUR LETTERHEAD

Harig

MANUFACTURING CORP. 5765 W. HOWARD ST. • CHICAGO 48, ILL.

Products by Harig Machine Tool Division











For more data circle 329 on Postpaid Card

Save time, improve checking accuracy with these Sundstrand accessories

A wide range of sizes in the most modern checking accessories available—that's what you get from Sundstrand. Industry wide acceptance of these Sundstrand accessories is your guarantee of outstanding performance.



6" x 18"	12" x 48"	24" x 48"
6" x 36"	12" x 60"	24" x 60"
12" x 36"	12" x 72"	24" x 72"

Check runout within .0001" limits

on gears, sprockets, pinions, etc. on this modern Sundstrand bench center insuring simpler assembly and higher production. Because of Sundstrand's "one-hand control" over-all movable elements, the other hand is left free to control rotation of the part. Complete table of sizes available is at left.

Quick, precise balancing of grinding wheels, pulleys, flywheels, etc., in a choice of nine sizes of balancing tools is offered by Sundstrand. These sensitive, durable tools are portable (except for No. 5 extra-heavy duty) and can be placed where needed without leveling. Capacities range from 12 to 24,000 lb., 21" to any swing desired, and from 20" to any length desired between standards.



For complete specifications on these accessories, write for Bulletin A-582.



SUNDSTRAND-AMERICAN BROACH

DIVISION OF SUNDSTRAND CORPORATION

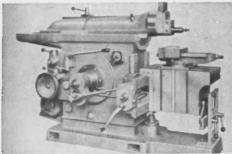
ANN ARBOR, MICHIGAN

For more data circle 330 on Postpaid Card

MODERN MACHINE SHOP

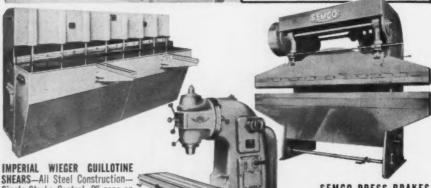
NEW 1961

EXTRAORDINARY PRECISION & QUALITY INCOMPARABLE BEST VALUES IN U. S. A.



EXCELSIOR Single Pulley SHAPER Model 625 FORCED FEED LUBRICATION SWIVELING TABLE

Stroke of ram	1911/4"
Cross adjustment of table	25%
Vertical adjustment of table	141/4"
Surface of table19"	
Number of strokes per minute 20-4	5-85-110
Motor power	2 H.P.



SHEARS—All Steel Construction— Single Stroke Control. 8" gaps on all models.

From 6', 14 gauge \$2384.00 To 12', ¼ gauge \$12,200.00

PEDERSEN Vertical and Horizontal MILLING MACHINES
10 Models from \$1785.

SEMCO PRESS BRAKES

6" and 8' models, 12 and 14 gauge to 35 tons.

Solid one piece lower bed. Extra large shut height 12½" full, ball roller bearings.

From \$3995.

AARON MACHINERY CO., Inc.

45 CROSBY ST., N. Y. 12 . WA 5-8300

For more data circle 331 on Postpaid Card

BRANCHES AT: MINEOLA, N. Y. OAKLAND, CAL. LOS ANGELES, CAL. HOUSTON, TEXAS

IGOG

SPECIAL PURPOSE PRECISION MOTORS

For Your Motor Applications that require Low Amplitude of Vibration, Extra Rigidity, and Special Shaft Extensions. Arranged to operate in Horizontal or Vertical Position, or as you specify.



Pope P-929-ASA — 1 to 20 HP—900 to 3600 RPM motorized spindle for heavy duty ball bearing raceway grinding.

Pope P-19000 Series Heavy Duty Precision Motors. Straight or tapered shafts

1 to 20 HP - 900 to 3600 RPM

.000025" (twenty five millionths) vibration amplitude

.000075" (seventy five millionths)





Pope P-3283 motorized cartridge type spindle for vertical or horizontal boring mills or turret lathes. 1 to 20 HP — 900 to 3600 RPM and High Cycle.

Coolant Connection I



Pope P-2500 Series heavy duty motorized spindles, 1 HP to 20 HP — 900 to 3600 RPM, for surface grinding, boring, and milling.



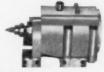
Pape P-922 super precision double-end totally enclosed motorized grinding head for producing low micro-inch surface finishes and accurate parts. 1 to 3 HP.



Pope P-6651-B Precision 1 to 3 HP motorized angularly adjustable head for tool and cutter grinders and special machines, such as blade grinders.



Pope P-16121 10 HP motorized, heavy duty deep hole (72" long) spindle for ID and OD grinding of large workpieces.



Pope P-5068-B High Cycle motorized spindle for grinding and milling up to 100,000 RPM; water cooled, oil mist lubricated.



Pope P-19162-AN "Anocut" electrolytic motorized grinding spindle, 1 to 20 HP; arranged to transmit from 50 up to 3000 amperes, at speeds up to 18,000 RPM.

Pope Motorized Spindles on special and automated machines assure you of continuous production of accurate parts. May we quote on your requirements?

No. 136

ROPE

ENGINEERS, DESIGNS AND BUILDS
PRECISION ANTI-FRICTION BEARING SPINDLES
FOR EVERY PURPOSE

POPE MACHINERY CORPORATION . 261 RIVER STREET . HAVERHILL, MASS.

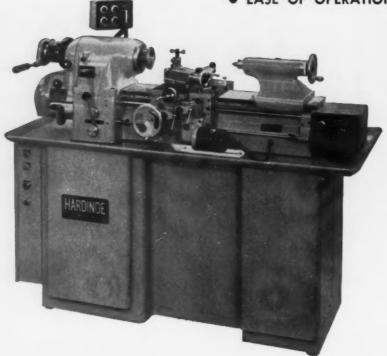
Established 1920

For more data circle 332 on Postpaid Card



"Outstanding Tool Room Lathe"

- EXTREME ACCURACY
 - HIGH SPINDLE SPEEDS
 - EASE OF OPERATION



Model HLV-H TOOL ROOM LATHE

Write for Bulletin HLV-H

HARDINGE BROTHERS, INC., ELMIRA, N. Y.

OFFICES IN PRINCIPAL CITIES. Export Office: 269 Lafayette St., New York 12, N. Y.
For more data circle 333 on Postpaid Card

26 MODERN MACHINE SHOP

October, 1961



DAKE Hydraulic Press Eliminates Multiple Forming Operations

At the Curtis Wire Products Company, Petoskey, Michigan, the difficult forming of wire mesh baskets is now done in one simple operation with a Dake 50-ton Hydraulic Guided Platen Press. The Dake Press saves considerable production time per basket by eliminating previous operations which formed only one side at a time.

The preset cycle of the Dake Press eliminates any possibility of operator error. After the wire mesh is placed in the die, the operator presses dual palm buttons which close the press rapidly until just before the wire mesh is contacted. It then slows to an adjustable pressing speed and forms the material smoothly and accu-

rately, without crimping formed corners. After forming, the press withdraws slowly to not distort the basket, then returns rapidly to the top of its stroke.

Every feature of a Dake Press is designed to save production time. The press stroke may be set to eliminate unnecessary travel. Rapid advance and rapid return increase the pressing cycle. Large bed area with ample daylight provides easy insertion and removal of pressed parts.

Dake Presses are available in capacities from 25 to 600 tons. For special applications, investigate the Dake line of Custom-Engineered Presses. Write for Catalog.

DAKE CORPORATION 612 Robbins Road, Grand Haven, Mich.

DAKE PRESSES









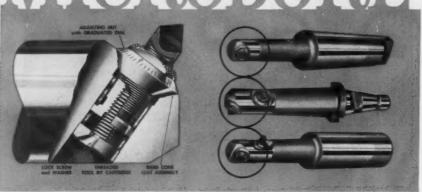




or more data circle 334 on Postpaid Card

the precision cutting tool system with built-in micrometer vernier adjustment

CKOBORE



Patented micrometer vernier adjustment! That's the exclusive feature that makes DeVlieg MICROBORE cutting tools so fast and easy to set. It's the built-in feature that eliminates trial and error cuts; reduces machine downtime and rejects. Micrometer vernier adjustment is also the feature that makes it easy to achieve accuracies impossible or extremely difficult to arrive at with conventional tooling. But that's only part of the story! Write for complete information on Microbore. Introduce yourself to a system of multipurpose tooling designed to deliver the utmost in precision and production from today's high performance machine tools.

DEVLIEG MICROSORE . DIVISION OF DEVLIEG MACHINE COMPANY . FAIR STREET . ROYAL OAK, MICHIGAN

MICROBORE . PRECISION TOOLING CENTER

For more data circle 335 on Postpaid Card



Amazing, how inexpensive complex finishing can be!

In some cases, the Pangborn Vibratory Finishing Machine has reduced finishing time by over 90%. You know what this means in time and labor savings alone. Especially since this machine tackles complex finishing assignments with the same ease and speed as simple ones.

Its uses are amazing, too. It descales, deburrs, burnishes, radiuses, fine-finishes. It handles a wide variety of materials . . . metals, plastics and ceramics. And this machine tackles complex and difficult jobs impossible or impractical to do by other methods . . . and does them quickly and economically.

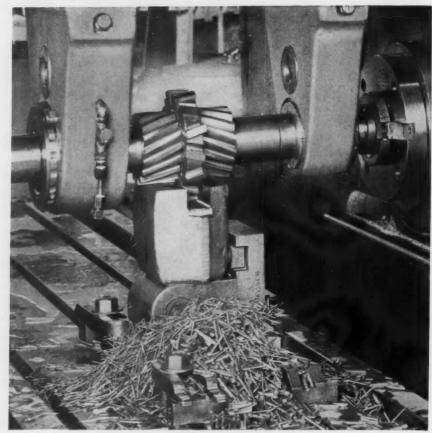
The exclusive air-cushioning system built into every Pangborn Vibratory Finishing Machine provides better and closer amplitude control and offers automatic adjustment for any weight load. Air-cushioned floor mounts eliminate any transmitted vibration. No special foundations are necessary. Variable speed controls available on all models. Automated and auxiliary equipment, media, compounds for every need. Send parts with exact finish specifications or finished specimen for sample processing in our laboratory to Mr. William Brandt at:

Pangborn Corporation, 5600 Pangborn Blvd., Hagerstown, Md. Pangborn Canada, Ltd., 47 Shaft Road, Toronto (Rexdale), Canada; or phone district office in Yellow Pages, "Sand Blast Equipment." Manufacturers of Vibratory Finishing, Blast Cleaning, Dust and Fume Control Equipment; Rotoblast* Steel Shot and Grit*9.

Pangborn

OF HAGERSTOWN

For more data circle 336 on Postpaid Card



For over 20 years



Bullard machine tool posts of 1945 SAE steel, forged, normalized, and enneeled are slotted and faced on top and two sides in the excellent time of 10 minutes per cut

BULLARD machine tool posts have been slot-and-slab milled with OK milling cutters

Bullard tool posts are standardized for both their vertical turret lathes and boring mills. Batches of 25 and 50 are constantly in the process of manufacture for replacements and new machine sales.

A B 1045 steel, normalized and sales are stored and feed on three aides in a single pass on a 50 HP Cincinnati Hypowermatic milling machine with a 6" OK inserted blade high speed steel alternate angle milling cutter flanked by two OK nobid high speed steel helical mills. Depth of slot, 1-3/8"; Depth of slab cut, 1/4". Speed, 42 rpm; Feed, 2-3/4" pm Total width of cut, 4-11/16". The inserted blade cutter remove 26.4 cubic inches of metal per pass while the flanking solid cutters remove 18.6 cubic inches of metal per pass while the flanking solid cutters remove 18.6 cubic inches. OK Tot Engineers can hely you with production data gained from hundreds of case histories. Put your problem up to them.

THE OK TOOL, COMPANY, INC. Millord, New Hamoshire

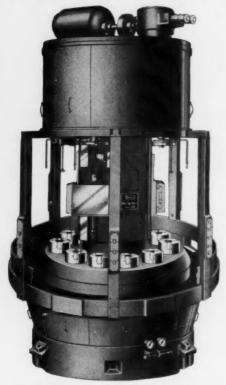
THE OK TOOL COMPANY, INC., Milford, New Hampshire



For more data circle 337 on Postpaid Card

BULLARD

THE PRICE IS LOWER!
THE PRICE IS LOWER!
THE PRICE IS LOWER!
THE PRICE IS LOWER!



with the NEW Bullard Mult-Au-Matic Type "M"

To achieve the same production output obtainable from a Bullard Mult-Au-Matic, Type "M", competitive methods would require a greater investment of capital funds.

Built to exacting Bullard standards, the Type "M", available with 6, 8, or 12 spindles, incorporates in its design many features which insures its rigidity, accuracy, and productivity, even on difficult machining jobs.

For complete Mult-Au-Matic, Type "M" information, write for a catalog or call your nearest Bullard Sales Office or Distributor.

The Bullard Company, Bridgeport 9, Conn.

仍治识别

PRICE

IS

LOWIER

For more data circle 338 on Postpaid Card

October, 1961

MODERN MACHINE SHOP

31



The only engraving machine with all these features for only \$325.

- 1 Adjustable copyholders...vary space between lines
- 2 Self-centering work holder
- 3 15 quick-change pantograph ratios

- Detachable engraving chassis . . . engraves right on work
- 5 Depth regulator with micrometer attachment
- G Carbide cutter

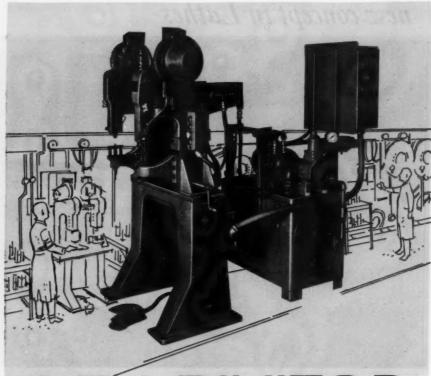
Cuts set-up time in seconds—cuts costs in half!

new hermes

ENGRAVING MACHINE CORP., 154 W. 14th St., New York 11, N.Y.

Los Angeles: 1346 N. Highland Ave. / Canada: 359 St. James St. W., Montreal, P.Q. For more data circle 339 on Postpaid Card

Send for catalog FM-9



A T-U RIVITOR

on your production line means higher production rate . . . lower unit cost!

T-J Rivitors and Clinchors are designed, engineered and manufactured to conform and operate efficiently on today's high-speed production lines. For whatever your product . . . if it demands a fastening assembly procedure . . . a T-J riveting or clinching machine adds to its high quality standards by their ability

in providing long, rugged service-free life.

Many standard designs to choose from . . . or a T-J can be custom designed for your exact requirements. Write Tomkins-Johnson, 2425 W. Michigan Ave., Jackson, Mich., today. Ask for Rivitor and Clinchor Bulletin No. 646 or Clinchor Bulletin No. 555.











TOMKINS-JOHNSON

MODERN MACHINE SHOP

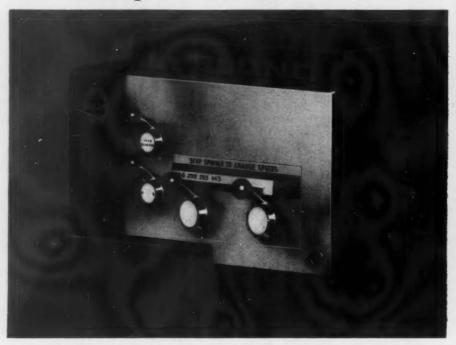
CYLINDERS

CUTTING TOOLS

For more data circle 340 on Postpaid Card

33

new concept in Lathes



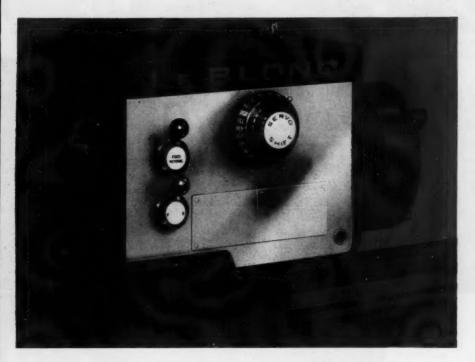
buy REGAL with manual shift.

Are you dubious about the advantages of hydraulic shifting on small lathes? Ingenious design of the new LeBlond Regal headstock lets you start with manual controls and add hydraulics in your shop at any time in the future! It's like having your cake and eating it, too.

The cost of adding the Servo-Shift package in the field is modest — just slightly more than original factory installation.

Brand new Regal Servo-Shift makes speed changing faster and easier than ever before. You select your next spindle speed while still cutting. Then move the control lever to brake position and get almost instantaneous automatic shifting—with no clashing of gears! This is the fastest and safest hydraulic shift available in a lathe today! It's simple and foolproof! It will make a hero out of every operator!

Our new Regal — the low-cost lathe with biglathe features — has many more important advantages not available in any other machine of the same class. Ask us to have a LeBlond field engineer stop and tell you about them, or write for our new descriptive Bulletin R-961 C



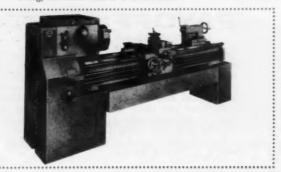
add SERVO-SHIFT later!

New LeBlond Regals are now available with 13", 15", 17" or 19" swing, and either manual or Servo-Shift.

World's largest builder of a complete line of lathes.



The R. K. LeBLOND MACHINE TOOL COMPANY Cincinnati 8, Ohio

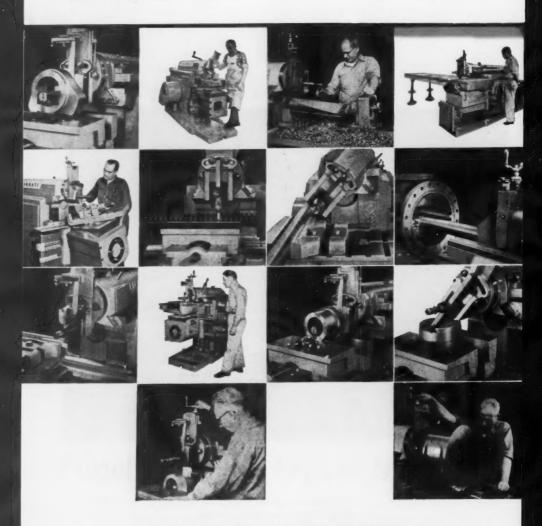


For more data circle 341 on Postpaid Card

October, 1961

MODERN MACHINE SHOP

35



PAYOFF: VERSATILITY

In the tool shop or in Four high production bay, the wide-ranging versatility of a Cincinnati Rigid Shaper gives you maximum productivity for your invested dollar. And for each of the many jobs you can do on it, a Cincinnati Rigid Shaper produces something extra—in metal cut per hour, in accuracy, in ease of operation. See for yourself why a new Cincinnati® Shaper would pay off for you: write Dept. G, for Catalog N-7.

Shapers / Shears / Press Brakes

THE CINCINNATI
SHAPER

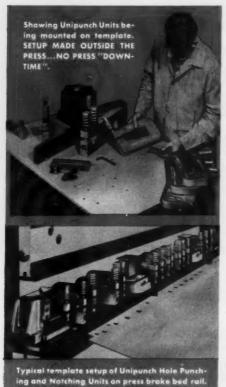


SHAPER co. Cincinnati 11, Ohio, U.S.A.

For more data circle 342 on Postpaid Card

Sess Apress Rate Footh

HOLE PUNCHING and NOTCHING UNITS



NOTE... NOTHING ATTACHED TO PRESS RA

SIMPLICITY cuts time and costs. This is the basic reason for standardizing on Unipunch Tooling System to produce custom hole punching and notching setups with standard units.

SIMPLY setup units outside the press according to desired hole punching and notching pattern; slide onto press bed; and start fabricating sheet metal parts with the first stroke of ram...nothing attached to press ram.

SIMPLIFIED design of self-contained Unipunch Units permanently align interchangeable punches and dies... no adjusting or aligning. These same units may be used and re-used in unlimited set-ups...no "dead" unproductive storage.

SIMPLIFY tooling and take full advantage of multiple savings by standardizing on Unipunch Equipment.

For the Hole Story Write Today for FREE



PUNCH PR

PUNCH PRODUCTS Corporation

Data Book "5"

382 BABCOCK ST., BUFFALO 6, N. Y.

Exclusive Canadian Licensee: WM. F. BEATTIE ASSOCIATES, HAMILTON, ONTARIO

For more data circle 343 on Postpaid Card

October, 1961

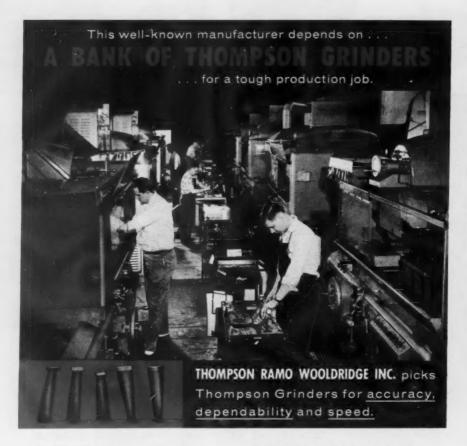
UNIFUNG

MODERN MACHINE SHOP

37

APER co. Cincinnati 11, Ohio, U.S.A.

more data circle 342 on Postpaid Card



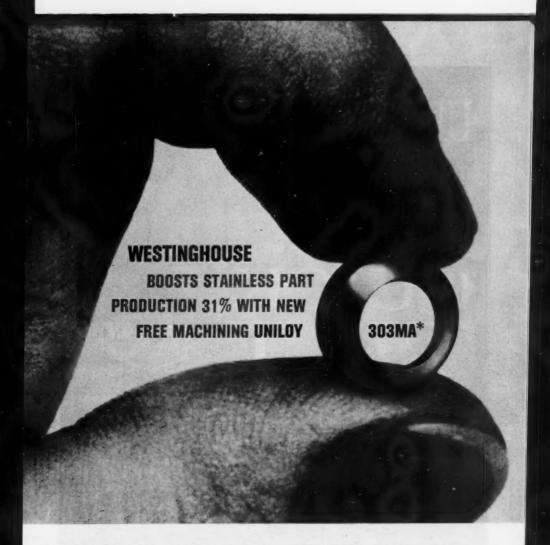
All the Thompson machines shown above in one bank are grinding jet aircraft engine compressor vanes. Each of the 5 surfaces on the root end as well as the concave and convex airfoil surfaces on the lug end are ground to extreme accuracy on the stainless steel forgings.

For the five years that these Thompson machines have been steadily on this job, downtime and maintenance costs have been negligible factors.

Put your toughest production job on a Thompson grinder and watch it cut your costs, speed your production and improve your product.



For more data circle 344 on Postpaid Card



The Westinghouse Standard Control Division at Beaver, Pa., compared New free machining Uniloy 303MA* stainless steel with regular Type 303. The part—a close tolerance spring end support for circuit breakers and control equipment—was machined from ½-inch stock. Here are the production line results:

| Spindle Speed | Spee

New Uniloy 303MA also machined cleaner and smoother to produce higher quality parts. It is now specified in all "U.S. PATERT NO. 2500.250

applications formerly calling for Type 303 stainless steel at this plant.

Cut your production costs! Order New Uniloy 303MA at your nearest Universal-Cyclops steel service center or sales office. Ask for your copy of the "Uniloy 303MA" brochure.



STAINLESS STEELS / TOOL STEELS / HIGH TEMPERATURE AND REFRACTORY METALS

For more data circle 345 on Postpaid Card

UP TO 200 HP

and tables to 90 inches

RIGID NEW

MATTISONS

with optional automatic cycling and

QUICK TILT

combine rough and finish machining in one operation

There's no comparison between these new Mattison Quick-Tilt rotaries and conventional surface grinders. They increase production $50\%_{\rm o}$, or more. They simplify wheel selection, extending the usable range of wheels. They increase wheel hie. And they give you both maximum efficiency and perfect flatness on every job. Ability to rough grind on the leading edge of the wheel, and then, in a matter of seconds, reset the spindle to its true perpendicular position of a fast finish grind, changes the entire economics.

of surface grinding. When you combine selector-switch actuated, power-spindle tilting; downfeeds to 165 in per minute, up to 200 hp on the spindle; optional automatic cycling, and Mattison's new box type construction | you have a whole new concept in flat machining. Stock-removal jobs, formerly milled, planed, or broached, have been switched to these high-powered, versatile rotaries to produce startling savings. We'll be happy to demonstrate — send your pieceparts to the Mattison. Methods Lab for a free sample grind and production estimate.)

MATTISON MACHINE WORKS Phone: W

Rockford, Illinois Phone: WO 2-5521

For more data circle 346 on Postpaid Card

MATTIEDN



We address this statement to design, tool, production, inspection and assembly engineers...

Holding to extremely close tolerances is a costly procedure. You know that. What you may not know is that frequently you can ease up on tolerances without sacrificing a single thousandth of your precise assembly objectives.

How? By using LAMINUM!

LAMINUM is the registered trade name for laminated shims whose layers are completely surface-bonded to look and act like solid metal. The layers are easily p-e-e-l-e-d to bring the shims to any desired thickness—for a thousandth fit right at assembly.

With LAMINUM in the specs, machining operations become less critical, faster and less costly. Inspection is simpler and less costly. The savings carry over to the assembly line, too. No stand-by equipment. No machining. No grinding. No counting, stacking or miking. And no dirt between layers—ever!

Get the facts about costsaving LAMINUM, and the custom-stamping service that goes with it. They're all illustrated and described in our Shim Design Folder No. 4. Write for it.

THE LAMINATED SHIM COMPANY, INC.

West Coast Sales and Service 600 SIXTEENTH ST., OAKLAND, CALIF.

Home Office and Plant
3310 UNION STREET, GLENBROOK, CONN.

IN BRASS • MILD STEEL • STAINLESS • ALUMINUM... WITH LAMINATIONS .002" OR .003"
NOW ALSO IN TITANIUM WITH LAMINATIONS .003"

For more data circle 347 on Postpaid Card

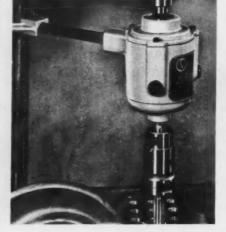
HIS A FACT!

You can tap 1/2" holes with a light drill press and Supreme's

New VersaTAPPER



Shaft of Model 6100 is held in drill press chuck. No. 6200 (above) has Tapered spindle.



VersaTAPPER is a compact precision-made tapping unit. Fits any drill press... features half-inch capacity range plus 4-time increase in torque. Easy to install. Simple and quick to remove after use.



Supreme Accutap Chuck is VersaTAPPER. Capacity 0-1/2"

VersaTAPPER... operates easily in any material ... with widest capacity range ... vet costs far less

The new VersaTAPPER has scored an instant success with production people everywhere. It has more versatility than other tapping devices. It has the widest capacity range-from 0 to 1/2", but depending on application, use of taps smaller than No. 10 is limited. It develops more power - makes the tapping of 1/2 "-13 holes a simpler matter, even with

light duty drill presses. VersaTAPPER is simple to use-can be successfully operated by anyone in your shop.

COMPLETE

All of these features at the remarkably low price of \$63.00 complete marks VersaTAPPER as a product you must see at the first opportunity. It's available at your local Supreme Chuck distributor. Call him soon.

PRODUCTS CORPORATION

CHICAGO 16, ILLINOIS

For more data circle 348 on Postpaid Card

You get more from power tools with **Top Quality Supreme Accessories**



Supreme Brand Chucks

Noted for unmatched quality. The widest range of sizes and types...one for every machine in your shop. Exclusive Su-preme hardening means greater accuracy-longer wear.



Supreme Versamatic

Reversible speed reducer for portable drills. Fits all makes -permits their use for power acrew driving, nut running and heavy duty drilling. 7 to 1 reduction means high torque increase. A fine tool.



Supreme Push-Pull Tapper

Like the Versamatic, but made for the single purpose of tapping with portable drills. Reverses instantly for tap removal. Handles taps up to 5/16' diameter. Top quality. Simple to

SUPREME PRODUCTS ARE IN STOCK IN YOUR CITY. CALL YOUR

DISTRIBUTOR

PRECISION ASR PRODUCTS

2222

For more data circle 347 on Postpaid Card

SAVE THIS AD FOR CHECKING FUTURE REQUIREMENTS

SPECIAL RH & LH

DIES • THREAD PLUG & RING GAGES



NEW SIZES ADDED DAILY ... IF NOT WRITE

The property is a second color of the		WHEN REQUESTING	QUOT	TIONS ALWAYS MENT	ION OU	ANTITIES	INQUIRIE	SENVITED
30-32-36-40-48-56-64-72 3-36-36-36-48-36-64-72 3-36-36-36-36-36-36-36-36-36-36-36-36-36	SITE						SIZE	THREADS PER INCH
198	0000							
0 38-84-74-89-30-80 2 48-32-54-55-66-64-72-80 36-40-60-64-72-80 36-40-60-64-72-80 37-21-30-92-34-38-42-48-30-55-66-64-72-80 38-22-73-30-32-38-44-48-30-55-66-64-72-80 39-55-60-64-72-80 4-61-52-32-38-42-48-30-55-66-64-72-80 39-55-60-64-72-80 4-61-52-32-38-42-48-30-55-66-64-72-80 39-55-60-64-72-80 4-61-52-32-38-40-44-48-50-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80	0000				2/0		1-1/2	
0 38-84-74-89-30-80 2 48-32-54-55-66-64-72-80 36-40-60-64-72-80 36-40-60-64-72-80 37-21-30-92-34-38-42-48-30-55-66-64-72-80 38-22-73-30-32-38-44-48-30-55-66-64-72-80 39-55-60-64-72-80 4-61-52-32-38-42-48-30-55-66-64-72-80 39-55-60-64-72-80 4-61-52-32-38-42-48-30-55-66-64-72-80 39-55-60-64-72-80 4-61-52-32-38-40-44-48-50-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80 39-56-60-64-72-80	000		13/64		41/64		1-17/32	
1 48.56-60-44-80-90 2 44.56-60-72-80-96 336-40-60-64-72-80 36-40-60-64-72-80 36-30-60-64-72-80 24-28-30-32-38-42-44-80-56-60-64-72-80 55-60-64-72-80 24-28-30-32-38-40-44-80-56-60-64-72-80 24-28-30-32-38-40-44-80-56-60-64-72-80 24-28-30-32-38-40-44-80-56-60-64-72-80 24-28-30-32-38-40-44-80-56-60-64-72-80 24-28-30-32-38-40-44-80-56-60-64-72-80 24-28-30-32-36-40 118-20-22-28-32-36-40 118-20-22-28-32-36-40 119-20-22-28-32-36-40 110-20-22-28-32-36-40 110-20-22-28-32-36-40 110-20-22-28-30-32-36-40 110-20-22-28-30-32-36-40 110-20-22-28-30-32-36-40 110-20-22-28-30-32-36-40 110-20-22-28-30-32-36-40 110-20-22-28-30-32-36-40 110-20-22-28-30-32-36-40 110-20-22-28-30-32-36-40 110-20-22-28-30-32-36-40 110-20-22-28-30-32-36-40 110-20-22-28-30-32-36-40 110-20-22-28-30-32-36-40 110-20-22-28-30-32-36-40 110-20-22-28-30-32-36-40 110-20-22-28-30-32-36-40 110-20-22-28-30-32-36-40 110-20-22-28-30-32-36-40 110-20-22-28-30-32-36-40 110-20-22-28-30-32-36-40 110-20-22-28-30-32-36-40 110-20-22-28-30-32-36-40 110-20-22-28-30-32-36-40 110-20-22-28-30-32-36-40 110-20-22-28-30-30-36-40-44-8-50-40 110-20-22-28-30-30-36-40-44-8-50-40 110-20-22-28-30-30-36-40-44-8-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-48-50-40-	0	56-64-72-80-90		20.22.24.26.27.28.30.32.				
2 48-22-54-56-60-72-80-94 3 36-40-60-44-72-80-94 3 0-32-38-38-42-44-56-60-64-72-80 3 0-32-38-38-42-44-56-60-64-72-80 5 24-28-30-32-38-40-44-56-56-60-47-28-0 7 28-30-32-38-38-40-44-56-56-60-47-28-0 7 28-30-32-38-38-40-44-56-56-60-47-28-0 9 24-28-30-32-38-40-64-72-80 18-20-22-28-22-30-38-40-44-56-56-64-72-80 18-20-22-28-30-38-40-44-56-56-64-72-80 18-20-22-28-30-38-38-40-44-56-56-64-72-80 18-20-22-28-30-38-30-32-36-38-40-68-56-60-47-28-0 18-20-22-28-32-36-0 18-20-22-28-32-36-0 18-20-22-28-32-36-0 18-20-22-28-32-36-0 18-20-22-28-32-36-0 18-20-22-28-32-36-0 18-20-22-28-32-36-0 18-20-22-38-32-36-0 18-20-22-38-32-36-0 18-20-22-38-32-36-0 18-20-22-38-32-36-0 18-20-22-38-32-36-0 18-20-22-38-32-36-0 18-20-22-38-32-36-0 18-20-22-38-32-36-0 18-20-22-38-32-36-0 18-20-22-38-32-36-0 18-20-22-38-32-36-0 18-20-22-38-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22-38-30-32-36-0 18-20-22	ĭ		1/34				1-9/10	
3 36-40-60-4-72-80	2		227		12/26			
4 30-32-38-42-44-56-60-64-72 5 72-80-90 7 7 7 7 8 7 8 7 8 8 7 8 8 8 8 8 8 8 8 8	3		18/64		11/10	24-26-27-28-30-32-36-40	1-5/8	
72 - 40-50 72 - 27-50 - 22 - 48-28 - 28 - 48 - 48-50 - 56 - 60-64 - 72 - 80 73 - 28 - 30 - 32 - 34 - 348 - 38 - 40 - 44 - 48-50 - 56 - 60-64 - 72 - 80 74 - 28 - 30 - 32 - 34 - 34 - 38 - 40 - 44 - 48-50 - 56 - 60-64 - 72 - 80 75 - 26 - 27 - 30 - 32 - 36 - 38 - 40 - 44 - 48-50 - 56 - 60-64 - 72 - 80 76 - 28 - 30 - 32 - 34 - 34 - 38 - 40 - 44 - 48-50 - 56 - 60-64 - 72 - 80 77 - 28 - 30 - 32 - 34 - 34 - 38 - 40 - 44 - 48-50 - 56 - 60-64 - 72 - 80 78 - 28 - 28 - 28 - 30 - 32 - 36 - 40 79 - 28 - 28 - 28 - 30 - 32 - 36 - 40 70 - 28 - 30 - 32 - 36 - 38 - 40 70 - 28 - 30 - 32 - 36 - 38 - 40 70 - 30 - 30 - 32 - 36 - 38 - 40 70 - 30 - 30 - 32 - 36 - 38 - 40 70 - 30 - 30 - 32 - 36 - 38 - 40 70 - 30 - 30 - 32 - 36 - 38 - 40 70 - 30 - 30 - 32 - 36 - 38 - 40 70 - 30 - 30 - 32 - 36 - 38 - 40 70 - 30 - 30 - 32 - 36 - 38 - 40 70 - 30 - 30 - 30 - 30 - 30 - 30 - 30 -	4			40	23/22	11 12 16 19 20 24 27 32	1	
5 22.73-30-32.36-38-42.44-8-50-56-60-64-72.80 5 24-22-30-33-36-40-44-8-50-56-60-64-72.80 5 24-22-30-33-36-40-44-8-50-56-60-64-72.80 5 24-22-30-32-36-40 5 24-22-30-32-36-40 5 24-22-30-32-36-40 5 24-22-30-32-36-40 5 24-22-30-32-36-40 5 24-22-30-32-36-40 5 24-22-30-32-36-40 5 24-22-30-32-36-40 5 24-22-30-32-36-40 5 24-22-30-32-36-40 5 24-22-30-32-36-40 5 24-22-30-32-36-40 5 24-22-30-32-36-40 5 24-22-30-32-36-40 5 24-22-30-32-36-40 5 24-22-30-32-36-40 5 24-22-30-32-36-40 5 24-22-30-32-36-40 5 24-22-30-32-36-40 5 24-22-32-32-36 5 24-22-32-32-36 5 24-22-32-32-40 5 24-22-32-30-32-36-40 5 24-22-32-32-40 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-30 5 24-22-32-32 5 24-22-32-32 5 24-22-32-32 5 24-22-32-32 5 24-32-32-32 5 24-32-32-32 5 24-32-32-32 5 24-32-32-32 5 24-32-32-32-32 5 24-32-32-32 5 24-32-32-32-32 5 24-32-32-32-32 5 24-32-32-32-32 5 24-32-32-32-32 5 24-32-32-32-32 5 24-32-32-32-32 5 24-32-32-32-32 5 24-32-32-32-32 5 24-32-32-32-32 5 24-32-32-32-32 5 24-32-32-32-32 5 24-32-32-32-32 5 24-32-32-32-32 5 24-32-32-32-32-32-32 5 24-32-32-32-32-32 5 24-32-32-32-32-32 5 24-32-32-32-32-32-32-32 5 24-32-32-32-32-32-32-32-32-32-32-32-32-32-		72-90-90		10-12-14-16-18-22-23-24-	23/32			
50-56-60-64-72-80 6-24-28-30-36-34-94-48-50-56-60-64-72-80 7-28-30-32-34-36-38-40-44-8-50-56-60-64-72-80 9-24-28-30-32-34-36-40-48-50-50-64-72-80 18-20-22-26-27-30-32-36-40 18-20-22-36-30-34-36-60-64-72-80 19-20-22-26-77-30-32-36-38-40-94-88-50-32-36-40-48-8-50-32-36-38-40-8-36-36-32-36-38-40-8-36-36-32-32-36-30-32-36-36-36-36-36-36-36-36-36-36-36-36-36-	4	27-27-30-32-36-38-42-48-	17.4		47/64			
56 - 66 - 47 - 28 - 30 - 32 - 34 - 34 - 44 - 48 - 54 - 44 - 48 - 50 - 24 - 24 - 24 - 25 - 27 - 28 - 32 - 34 - 34 - 34 - 44 - 48 - 54 - 44 - 48 - 54 - 44 - 4			1			6-8-9-11-12-14-15-18-20-	1-3/4	5-6-8-10-12-13-14-16-18-
7 28.30-23-43-53-84-0.44-48-54-66-87-280 24-28-32-32-34-61 22-22-28-32-34-36-46-87-280 24-28-32-34-36-46-87-280 24-28-32-34-36-46-87-280 24-28-32-34-36-46-87-280 24-28-32-34-36-46-87-280 24-28-32-34-36-46-87-280 24-28-32-34-36-46-87-280 24-28-32-36-40-88-56-60-64-72-36-46-88-56-60-64-72-36-46-88-56-60-64-72-32-34-32-36-40-88-56-60-64-72-32-32-38-40-88-56-66-64-72-32-32-38-40-88-56-66-64-72-32-32-38-40-88-56-66-64-72-32-32-38-40-88-56-66-64-72-32-32-38-40-88-56-66-64-72-32-32-38-40-88-56-66-64-72-32-32-38-40-88-56-66-64-72-33-32-38-40-88-56-64-72-33-32-38-40-88-56-64-72-32-32-38-40-88-56-64-72-32-32-38-40-88-56-64-72-32-32-38-40-88-56-64-72-32-32-38-40-88-56-64-72-32-32-38-40-88-56-64-72-32-32-38-40-88-56-64-72-32-32-32-38-40-88-56-64-72-32-32-32-38-40-88-56-64-72-32-32-32-38-40-88-56-64-72-32-32-32-38-40-88-56-64-72-32-32-32-38-40-88-56-64-72-32-32-32-38-40-88-56-64-72-32-32-32-32-32-32-32-32-32-32-32-32-32	6		17/64	17-18-20-74-27-28-37-40	20.1	22-24-26-27-28-30-32-36-		20-24-28-32-40
7	-			40		40-48-60-72	1.767	18
8 24.2-28.3-0.38-40-44-48-50-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-56-60-64-72-5	2		9/32	16-18-20-24-26-27-28-32-	49/64		1.7715	12
8							1-13/16	8-10-12-14-16-18-20-24-82
56-60-64-72-80-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-72-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-80-76-			19/64	18-24		16		
9	-	56-60-64-72-80	300		13/16	8-10-12-14-16-18-20-24-27-	1-1/0	
18	9	24-28-30-32-36-40		10-12-14-16-20-22-26-27-	1		1 20/22	
40.48.56.00.64.72.80.76.6 12 20.22.26.73.03.23.64.0 13 20.22.26.73.03.23.64.0 14 65.65.06.74.72.80 15 20.22.26.73.03.23.65.60.44.85.60 16 18.20.22.24.83.24.0 16 18.20.24.28.32.40 16 18.20.24.28.32.40 17 18.20.24.32.40 18 16.12.02.24.32.40 18 16.12.02.24.32.40 18 16.12.02.24.32.40 18 16.12.02.24.32.40 19 18.20.24.32.30 18 16.12.02.44.32.32.60 19 18.20.24.32.32.60 19 18.20.24.32.32.60 19 18.20.24.32.32.60 19 18.20.24.32.32.60 19 18.20.24.32.32.60 19 18.20.24.32.32.60 19 18.20.24.32.32.60 19 18.20.24.32.32.60 19 18.20.32.32.60.40.44.85.66 10 12.14.16.18.20.24.27.28.32.40 11.62.00 11.62.00 12.14.16.18.20.24.27.28.32.40 13.62.00 12.14.16.18.20.24.27.28.32.40 13.62.00 12.14.16.18.20.24.27.28.32.40 13.64.00 12.14.16.18.20.24.27.28.32.40 13.64.00 12.14.16.18.20.24.27.28.32.40 13.64.00 13.64.66.06.67.2 28.30.32.36.40.44.86.56 28.44.16.20.32 14.16.20 29.66.66.66.67.2 28.30.32.36.60 10.12.14.16.18.20.24.27.28.32.32.36.40 10.12.14.16.18.20.24.27.28.32.32.32.36.40 10.12.14.16.18.20.24.32 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.62.00 11.	10		20.00		.835			
12 20-22-26-27-30-32-36-38-40-44 40-45-66-06-47-72-80 13 20-22-24-28-32-40 14 16-18-26-23-30-32-36-40-44 15 20-22-34-28-30-32-36-40 16 16-18-20-22-34-28-32-36 16 16-18-20-22-32-40 16 16-20 17 16-20 18 16-18-20-22-32-40 18 16-18-20-22-32-40 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 10 12-16-18-20-24-27-28-30-24 28 14-16-20-32 16-18-20-24-32 28 14-16-20-32 16-18-20-24-32 28 14-16-20-32 16-18-20-32-36-40 17/16 16-20-32 17/16 16-20-32-32-36-40 17/16 18-20-32-36-38-40 17/16 18-20-32-36-38-40 17/16 18-20-32-36-38-40 17/16 18-20-32-38-40 17/16 18-20-32-38-40 17/16 18-20-32-38-40 17/16 18-20-32-38-40 17/16 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-32-40 18-20-32-32-40 18-20-32-32-		40-48-56-60-64-72-80-96		56-64	55/64	6-12		
12 20-22-26-27-30-32-36-38-40-44 40-45-66-06-47-72-80 13 20-22-24-28-32-40 14 16-18-26-23-30-32-36-40-44 15 20-22-34-28-30-32-36-40 16 16-18-20-22-34-28-32-36 16 16-18-20-22-32-40 16 16-20 17 16-20 18 16-18-20-22-32-40 18 16-18-20-22-32-40 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 19 18-20 10 12-16-18-20-24-27-28-30-24 28 14-16-20-32 16-18-20-24-32 28 14-16-20-32 16-18-20-24-32 28 14-16-20-32 16-18-20-32-36-40 17/16 16-20-32 17/16 16-20-32-32-36-40 17/16 18-20-32-36-38-40 17/16 18-20-32-36-38-40 17/16 18-20-32-36-38-40 17/16 18-20-32-38-40 17/16 18-20-32-38-40 17/16 18-20-32-38-40 17/16 18-20-32-38-40 17/16 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-38-40 18-20-32-32-40 18-20-32-32-40 18-20-32-32-	11	20-22-26-27-30-32-36-40	21/64	16-18-20-24-36	27/32	9-10-18-20-24-27-32-40-48	2	4%-6-8-10-12-14-16-18-20-
40.48-56-05-472-30 13 20.22-42-32-32-40 14 16-18-26-28-30-32-36-36 15 38-20-42-32-40 16 18-20-22-36-32-36 16 18-20-22-36-32-36 16 18-20-22-36-32-36 16 18-20-22-36-32-36 16 18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 16-18-20-22-32-40 18 18-18-18-18-20-22-32-32-40 18 18-18-18-18-20-22-32-32-40 18 18-18-18-18-20-22-32-32-40 18 18-18-18-18-20-22-32-32-40 18 18-18-18-18-20-22-32-32-40 18 18-18-18-18-20-22-32-32-40 18 18-18-18-18-20-22-32-32-40 18 18-18-18-18-20-22-32-32-40 18 18-18-18-18-20-22-32-32-40 18 18-18-18-18-20-22-32-32-40 18 18-18-18-18-20-22-32-32-40 18 18-18-18-18-20-22-32-32-40 18 18-18-18-18-20-22-32-32-40 18 18-18-18-18-20-22-32-32-40 18 18-18-18-18-20-22-32-32-40 18 18-18-18-18-20-22-32-32-40 18 18-18-18-18-20-22-32-32-40 18 18-18-18-18-20-22-32-32-40 18 18-18-18-18-20-22-32-32-40 18 18-18	12	20-22-26-27-30-32-36-38-	11/32	16-18-20-22-24-26-27-28-	.850			
14		40-48-56-60-64-72-80	1	32-36-40-64	7/8			8-10-12-14-16-18-20-24-32
10-12-14-18-20-24-28-32-40 16-18-20-24-28-32-36 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40 16-18-20-24-32-40	13	20-22-24-28-32-40	23/64	16-24		26-27-28-30-32-36-40		4%-8-10-12-14-16-18-20-32
18	14		.365		29/32	9-12-14-18-20-24-27-28-32		8-10-12-14-16-18-20-24
18		40-64	3/8	10-12-14-18-20-22-26-27-	15/16	8-9-10-12-14-16-18-20-24-		
18	15	18-20-24-28-32-40		28-30-32-36-40-44-48-56-	1.61	26-27-28-32-40		8-10-12-14-16-18-20-24
18	16	16-18-20-22-24-28-32-36	1		31/32	8-9-12-14-16-18-20-24-28-32		4-8-10-12-14-16-18-20-32
18-20 20 14-16-18-20-24-92 21 16-18-20-24-18 21 22 16-18-20-24-18 21 24 14-16-18-20-24-27-28 22 26 16-18-20-24-28 27-64 14-20-24-28-32-36 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-64 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74 27-74	17				1			8-10-12-14-16-18-20
22 16.18-20-24-52 27.66 14.20-24-82.23-65 27.16 14.20-24-82.23-65 27.16 14.20-24-82.23-65 27.16 14.20-24-82.23-65 27.16 14.20-24-82.23-65 27.16 14.20-24-82.23-65 27.16 16.20-32 27.16 14.20-24-82.23-16.20-32-84-94.85-10-12.14-16.18-20-32-94-82.23-16.20-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-20-32-12.14-16.18-	18	16-18-20-24-32-40				24-26-27-28-30-32-36-40-48		4-6-8-10-12-14-16-18-20
17/16 96-60-64-72 5/44 56-06-64-72 5/45 56-06-64-72 5/46 56-06-64-72 5/46 56-06-64-72 5/46 56-06-64-72 5/47 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-	19		13/32	12-14-16-18-20-24-27-28-		8-12-14-16-18-20		8-10-12-14-16-18-20
17/16 96-60-64-72 3-1-76-60-64-72 37-76-60-64-72 37-76-64-72-76-64-76-76-60-64-72 37-76-64-76-76-64-76-76-76-76-76-76-76-76-76-76-76-76-76-	20	14-16-18-20-24-32		32-36-40				4-8-10-12-14-16-20-32
17/16 96-60-64-72 5/44 56-06-64-72 5/45 56-06-64-72 5/46 56-06-64-72 5/46 56-06-64-72 5/46 56-06-64-72 5/47 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-	22				1-1/16		2-11/16	8-10-12-14-16-18-20-32
17/16 96-60-64-72 5/44 56-06-64-72 5/45 56-06-64-72 5/46 56-06-64-72 5/46 56-06-64-72 5/46 56-06-64-72 5/47 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-	24	14-16-18-22-24	7/16		1	20-24-27-28-32-40	2-3/4	4-8-10-12-14-16-18-20-32
17/16 96-60-64-72 5/44 56-06-64-72 5/45 56-06-64-72 5/46 56-06-64-72 5/46 56-06-64-72 5/46 56-06-64-72 5/47 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-	26							4-8-10-12-14-16-18-20-24-32
17/16 96-60-64-72 5/44 56-06-64-72 5/45 56-06-64-72 5/46 56-06-64-72 5/46 56-06-64-72 5/46 56-06-64-72 5/47 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-64-72 5/48 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-78 56-06-	28			12-14-16-20	1-1/8	8-10-14-16-18-20-24-27-28-	Z-15/16	8-10-12-14-16-18-20-32
5/64 56-60-64-72 31/64 12-13-20-24-32 11/64 12-13-20-24-32 11/64 12-13-20-24-32 11/64 12-13-20-24-32 11/64 12-13-20-24-32 11/64 12-13-20-24-32 11/64 12-13-20-24-32 11/64 12-13-20-24-32 11/64 12-13-20-24-32 11/64 12-13-20-24-32 11/64 12-13-20-24-32 11/64 12-13-20-24-32 11/64 12-13-20-24-32 11/64 12-13-20-34-32 11/64 12-13-20-34-32 11/64 12-13-20-34-32 11/64 12-13-20-34-32 11/64 12-13-20-34-32 11/64 12-13-20-34-32 11/64 12-13-20-34-32 11/64 12-13-20-34-32 11/64 12-13-20-34-32 11/64 12-13-20-34-32 11/64 12-13-20-34-32 11/64 12-13-20-34-32 11/64 12-13-20-34-32 11/64 12-13-20-34-34-34-34-34-34-34-34-34-34-34-34-34-	30	14-16-20	15/32				3	
3/3/2 32-36-38-48-50-56-60-64 100 100 100 100 100 52 26-72-72-8-30-32-36-0-44- 48-50-56 17/2 10-11-12-14-16-18-20-24- 48-50-56 17/64 36-40-42-44-48-50-56 17/32 10-12-13-14-16-18-20-24- 27-28-32-32-40-68 20-24- 27-28-32-32-40-68 20-24- 27-28-32-32-40-68 20-24- 27-28-32-32-40-68 20-24- 27-28-32-32-40-68 20-24- 27-28-32-30-32-36-38-40-50 20-24- 27-28-32-32-40-48 26-27-28-32-40-48 26-27-28-32-40-48 26-27-28-32-40-48 26-27-28-32-40-48 26-27-28-32-40-48 26-27-28-32-40-48 26-27-28-32-40-48 26-27-28-32-40-48 26-27-28-32-40-48 26-27-28-32-40-48 26-27-28-32-40-48 26-27-28-32-40-48 26-27-28-32-40-48 26-28-28-32-40-48 26-28-28-32-40-48-26-28-28-32-40-48-26-28-28-28-28-28-28-28-28-28-28-28-28-28-					1-5/32	7-8-9-12-14-16-18-20-24-32		4-8-10-12-14-16-20
100 100 26-27-28-30-32-36-40-44- 107 52 0-107-28-30-32-36-40-44- 108 30-32-36-38-40-49-56-60-80 33/-64 12-13-20-24- 132 50 30-32-38-40 0-49-56-60-80 79/-64 30-32-38-40-49-56-80-97/-6 28-30-32-38-40-49-56-30-32-36-38-40-38-56-30-32-36-40-48-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-40-38-56-30-32-36-38-38-30-32-38-30-38-30-32-38-	5/64	56-60-64-72		12-13-20-24-32	1-11/64	18		4-8-10-1X-14-16-20
107 52 7/64 36-40-42-44-48-50-56 1/82 0-24-27-28-32-40 -48 36-40-48-56-60 80 1/82 24-22-28-24-48 1-3/8 58-10-12-16 1-8-20-24-27-28-32-40-48 1-3/8 58-10-12-16 1-8-20-24-27-28-32-40-48 1-3/8 58-10-12-16-18-20-24-27-28-32-40-48 1-3/8 58-10-12-16-18-20-24-27-28-32-30-32-38-40-50 57/6 10-12-18-16-18-20-24-27-28-32-30-32-38-40-50 57/6 10-12-18-20-24-27-28-32-30-32-38-40-48-56-80 17/64 24-27-28-32-40-48 1-3/8 58-10-12-16-18-20-24-27-28-32-30-32-38-40-48-56-80 17/64 24-27-28-32-40-48 1-3/8 58-10-12-16-18-20-24-27-28-32-30-32-38-40-48-56-80 17/64 24-27-28-32-40-48 1-3/8 58-10-12-16-18-20-24-27-28-32-30-32-38-40-48-56-80 17/64 24-27-28-32-40-48-56-80 17/64 24-27-28-32-40-48-56-80 17/64 24-27-28-32-40-48-56-80 17/64 24-27-28-32-40-48-56-80 17/64 24-27-28-32-40-48-56-80 17/64 24-27-28-32-40-48-56-80 17/64 24-27-28-32-40-48-56-80 17/64 24-27-28-32-40-48-56-80 17/64 24-27-28-32-40-48-56-80 17/66 38-10-12-16-18-20-24-27-28-32-40-48-56-80 17/64 24-27-28-32-40-48-56-80 17/64 24-27-28-32-40-48-56-80 17/66 38-10-12-16-18-20-24-27-28-32-40-48-56-80 17/66 38-10-12-16-18-20-24-27-28-32-40-48-30-32-38-40-48-56-80 17/66 38-10-12-16-18-20-24-27-28-32-40-48-30-32-38-40-48-56-80 17/66 38-10-12-16-18-20-24-27-28-32-40-48-30-32-38-40-48-56-80 17/66 38-10-12-16-18-20-24-27-28-32-40-48-30-32-38-40-48-56-80 17/66 38-10-12-16-18-20-24-27-28-32-40-48-56-80 17/66 38-10-12-16-18-20-24-27-28-32-40-48-56-80 17/66 38-10-12-16-18-20-24-27-28-32-40-48-56-80 17/66 38-10-12-16-18-20-24-27-28-32-40-48-56-80 17/66 38-10-12-16-18-20-24-27-28-32-40-48-56-80 17/66 38-10-12-16-18-20-24-27-28-32-40-48-56-80 17/66 38-10-12-16-18-20-24-47-18-48-10-12-16-18-20-24-47-18-48-10-12-16-18-20-24-48-10-12-16-18-20-24-48-10-12-16-18-20-24-48-10-12-16-18-20-24-48-10-12-16-18-20-24-48-10-12-16-18-20-24-48-10-12-16-18-20-24-48-10-12-16-18-20-24-48-10-12-16-18-20-24-48-10-12-16-18-20-24-48-10-12-16-18-20-24-48-10-12-16-18-20-24-48-10-12-16-18-20-24-48-10-12-16-18-20-24-48-10-12-16-18-20-24-48-10-12-16-18-20-24-48-10-12-16-18-20-24-48-10-12-16-18-20-24-48-10-12-16-18-20-24-48			1/2		1-3/16			4-8-10-12-14-16-20
7/64 36-40-42-44-48-50-56 33/64 12-13-20-24 32-40-48-50-56 33/64 12-13-20-24 32-40-48-50-56 32-34-38-40-48-56-60-80 33/64 12-13-20-24-27-28-32-40-48 3-5/8 4-8-10-12-16 3-5/8 4-8-10-12-16 3-5/8 4-8-10-12-16 3-5/8 4-8-10-12-16 3-5/8 4-8-10-12-16 3-5/8 4-8-10-12-16 3-5/8 4-8-10-12-16 3-5/8 4-8-10-12-16 3-5/8 4-8-10-12-16 3-5/8 4-8-10-12-16 3-5/8 4-8-10-12-16 3-5/8 4-8-10-12-16 3-5/8 4-8-10-12-16 3-5/8 4-8-10-12-16 3-5/8 4-8-10-12-16 3-5/8 4-8-10-12-16 3-5/8 4-8-10-12-16 3-5/8 4-8-10-12-16 3-5/8 4-8-10-12-16 3-5/8 4-8-10-12-16 3-5/8 4-8-10-12-16 3-5/8 4-8-10-12-16 3-5/8 4-8-10-12-16 3-5/8 4-8-10-12-16 3-5/8 3-5/8 4-8-10-12-16 3-5/8 3-5/8 4-8-10-12-16 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8 3-5/8	100		1					4-8-10-11-12-14-10-18-20
1/8 20-32-36-38-40-48-56-60-80				48-56-70-72-80	1-1/4	8-10-14-16-18-20-24-27-28-		4-8-10-1Z-16
132 50 27-28-32-40-64 30-32-38-40 550 24 8-10-12-16 550 24 8-10-12-16 5732 24-28-30-32-36-38-40-50 37/64 10-13-14-16-20-24-26-27-28-30-32-36-38-40 57/64 10-13-14-16-20-24-26-27-28-30-32-36-38-40 57/64 10-12-18-20-27 11-3/8 12-16-18-20 1-13/8 12-16-18-20-24-4-1/8 4-8-10-12-16 stock up 1-7/66 28-10-12-14-16-18-20-24-4-1/8 4-8-10-12-16 to 6° dis.	7/64							4-8-1U-1Z-10
9/64 50-32-38-40 550 24 1-3/8 58-10-14-16-18-20-24-27- 3-7/8 4-8-10-12-16 Many more 1/48 38 24-22-30-32-36-38-40-50 27/6 10-13-14-16-20-24-26-27- 28-30-32-36-38-40-50 27/6 10-12-18-20-27- 11-3/22 12-16-18-20-24-17-8 4-8-10-12-16 16 stock up 1/6-6 24-16-36-30-32-36-38-40 37/64 10-12-18-20-27- 11-3/22 12-16-18-20-24- 4-1/8 4-8-10-12-16 16 stock up 1/6-6 3-10-12-16-16-18-20-24- 4-1/8 4-8-10-12-16 16 stock up 1/6-30-32-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-40 18-30-32-36-38-30-30-32-36-38-30-30-3	1/8		17/32	10-12-13-14-16-18-20-24-	1-5/16	0-7-3-10-12-14-16-18-20-	3-3/8	7-6-10-12-10
148 38 24-26-28-30-32-36-38-40-50 28-30-32-36-38-40-50 28-30-32-36-38-40-50 28-30-32-36-38-40-50 28-30-32-36-38-40-50 28-30-32-36-38-40-50 28-30-32-36-38-40-50 28-30-32-36-38-40-50 28-30-32-36-38-40-50 28-30-32-36-38-40-50 28-30-32-36-38-40-48-56-80 1-13/32 12-16-18-20-24-1/8 4-8-10-12-16 to 6° dia.				27-28-32-40-64	2 2/0	24-21-28-32-40-48		
5/32 24-26-28-30-32-36-38-40-50 28-30-32-36-40-48-56-80 1-13/32 12-16-18-20 16 16 to 6* dia.	9/64		.550		1-3/8	3-8-1U-14-10-18-2U-24-27-		
11/64 24-26-30-32-36-38-40 37/64 10-12-18-20-27 1-7/16 6-8-10-12-14-16-18-20-24- 4-1/8 4-8-10-12-16 to 6" dia.			7/16		1 19/99		4	
	3/32		27/66				4.1/8	4.8.10.12.16 to 6" 41
					1-1/10			4.9.10.12.16

LEFT HAND N.C. (USS)-N.F. (SAE) SIZES

	SEE	ABOVE	SECTIO	N FOR	MORE S	SIZES	
SIZE	THREADS	SIZE	THREADS	SIZE	THREADS	SIZE	THREADS
0	80	8	32-36	7/16	14-20	1"	8-12-14
1	64-72	10	24-32	11/2	13-20	1-1/8	7-12
2	56-64	12	24-28	9/16	12-18	1-1/4	7-12
3	48-56	14	20-24	5/8	11-18	1-5/16	6-12
4	36-40-48	1/4	20-28	11/16	11-16	1-3/8	6-12
4	40-44	5/16	18-24	3/4	10-16	11-7/16	6-12
6	32-40	3/8	16-24	7/8	9-14	11-1/2	6-12

'OVERSIZE' and 'UNDERSIZE' TAPS

RIGHT AND LEFT HAND N.C. AND N.F. SIZES

MACHINE SCREW #2 to #5 MACHINE SCREW #6 to #14 FRACTIONAL 1/4" to 1-1/2"

Plus	80	Minus	.002,	.003,	.005
Plus	er	Minus	.003,	.005,	.010
Plus	90	Minus	.003,	.005,	.010
			64.0	2 /64	9.79.9

Right Hand—Unlisted 'Pulley' Right & Left Hand-Unlisted 'Gun' or Spiral Pointed Taps Size Threads Size Size Threads Size Threads 5/4 36-40 NC, 48 NF 7/16 5 40 NC, 44 NF 1/2 Threads | Size 0 80 MF 1 56 NS 7/8 91 2 56 NC, 64 MF 1 8 NC, 9/16 12 NC, 18 NC 1-1/8 71 5/8 11 NC, 18 NF 1-1/4 71 11/16 11 NS, 16 NS 1-3/8 61 3/4 10 NC, 16 NF 1-1/2 61

-	1		
	1		ACME
12,40,40,40,40,40,40	14 NF 8 12 NF 10 12 NF 12 12 NF 1/4 12 NF 5/16	32 NC, 36 NF 24 NC, 32 NF 24 NC, 28 NF 28 NF 24 NF	5/8 3/4 Also Large

And Extra Length Taps

Threads 24 NF 20 NF 20 NF 12 NC 18 NF 18 NF 16 NF

Right H	land "Pipe	" Taps
"NPT" Taper "NPT" Size Thread	Size Thread	"NPT" &
1/16 27 1/4 27	1:1/2 11%	Size Thread
2-1/2 8 3 3-1/2 8	2-1/2 8 ⁷² 3-1/2 8	1/4
4 8 Also British	Also British	3/4 14

UNLISTED

	Hand oper and		
Size	Thread	Size	Thread
1/16	27	1	1136
1/8	27	1-1/2	1112
3/8	18	2 2 1/2	111/2

3-1/2

Also British

TAPS IN STOCK

Get all 3.. DELIVERY W QUALITY PRICE

IF NOT IN STOCK - 7 to 10 DAYS DELIVERY - When ordering or requesting quotations for Acme Taps, kindly furnish following information:

16) Also Britts:

(a) Kind of meterial being machi
(b) Depth of hole in inches, through
bettom hole. (c) Tae to be used here
bettom hole. (c) Tae to be used here
piece expected to be turned. (a) Is
piece expected to be done in one
(f) Would tap be backed out of hole
machine stepped for release of lap. (i)
machine stepped for release of lap. (i)
which is the print

Cutting Taols

31 S. BESPLAINES CHICAGO 4, ILL. All Phones: Financial 6-1193



The superior strengths and values that give a Minster Piece-Maker press the most precision and the best stability for high speed automatic stamping jobs are "hidden" in the Minster design and construction.

That's why it is important to you, when evaluating press equipment for progressive die operation, to carefully compare frame structure, precision of bearing and gib fitting, slide to bed parallelism, eccentric shaft support, lubrication system and control and clutch efficiency. Every size Piece-Maker. 20 through 300 tons, has this superiority. Ask a Minster representative to show you exactly why this is true.

The Minster Machine Company, Minster, Ohio

MINSTER

For more data circle 350 on Postpaid Card



Position the tool—not the work with this new Delta Unidrill*



New Delta Unidrill line is available in bench and floor models or as components for custom assembly. Choose Utility or Deluxe Head, High or Slo Speed, Key Chuck or Tapered Spindle.

FREE BROCHURE catalogs full Radial Drill Press line. Write: Rockwell Manufacturing Company, Delta Power Tool Division, 606K N. Lexington Ave., Pittsburgh 8 Pa.

For more data circle 351 on Postpaid Card

It's the unique double-swivel design that gives this new 2-foot arm radial drill press such big job capacity-in metal or wood. You can do more jobs faster and easier because you can move and tilt the drill head-position the cutting tool to the work in five different ways! This saves the cost of expensive jigs and cuts time-consuming shifting of the work.

You can drill to the center of a 48" circle—on or off the table. And with six interchangeable spindles or spindle adapters, you can change in seconds to handle reaming or spot facing of metal, routing or planing of wood, and many other jobs.

The only way to see how the Unidrill can solve your drilling problem is to see this flexibility in action. Your Delta Industrial Distributor (under TOOLS or MACHINES in the Yellow Pages) will gladly demonstrate. Call him. *Trademark

DELTA INDUSTRIAL TOOLS

another fine product by









Competitive Pressrooms Can Produce and Earn More—with a Nilson FOURSLIDE

The NILSON machine, which combines a crank or toggle press with FOUR-SLIDE forming motions, produces complex stampings in one operation. Standard NILSON FOURSLIDES incorporate built-in stock straightening and feeding mechanisms, together with cam-actuated horizontal and vertical motions, providing many production advantages:

- · Eliminate expensive camming and tooling
- · Reduce material costs-no carrier for metal strip
- . High production rates-up to 200 parts / minute
- · Quick-change cams for fast changeover
- Utilizes lower cost adjustable form tools and dies for multiple sizes
- · Automatic scrap disposal in the horizontal press
- · Additional motions readily available from four camshafts
- · Also handles wire forms requiring press operations
- . Forms wide range of part sizes-up to 4" wide; 16" long
- · Forms on two levels, and minimizes stripping problems



Full explanation of the NILSON FOURSLIDE PROCESS is available in the "FOURSLIDE Design & Tooling Handbook", which is yours for



THE A. H. NILSON MACHINE CO. . 627 Bridgeport Avenue . Shelton, Conn.

For more data circle 352 on Postpaid Card



Polarad inspectors see .001" vanes magnified like this with STEREOZOOM® MICROSCOPES

These are micro-grid vanes for the higher frequency microwave electron tubes made by Polarad Electronics Corporation, Long Island City, N. Y. Bausch & Lomb StereoZoom Microscopes play a critical part in their inspection. Because only B&L StereoZoom Microscopes provide infinite choice of magnification, anywhere within the entire range of the instrument. Just a turn of the Zoom knob shows their .001" vanes at the ideal magnification for checking continuity, spacing, surface finish, or contamination by foreign materials.

Work shows up vividly in natural 3D detail. And there's unobstructed working distance (up to 7") to simplify Polarad's precision assembly of tube parts. That's why Maurice J. Cunniffe, manager of Polarad's Microwave Tube Laboratory, says: "The StereoZoom Microscope is an essential component of our laboratory

Why not mail the coupon and find out how StereoZoom Microscopes can help you?

BAUSCH & LOMB

Made in America, to the world's highest standards.

BAUSCH & LOMB INCORPORATED 87222 Bausch St., Rochester 2, New York

- Send new B&L StereoZoom Catalog D-15.
- Schedule a demonstration at my convenience.

Company .

Address

For more data circle 353 on Postpaid Card

October, 1961

facility."

MODERN MACHINE SHOP



46

AIR-POWERED EQUIPMENT



Bellows LUBRI-AIR CONTROL UNIT

HERE'S WHY: Once adjusted to the requirements of a particular air system, the Bellows Lubri-Air Control Unit automatically filters harmful dirt and moisture out of the air stream (40 micron filter element standard; 5, 10 and 20 micron units available) . . . automatically regulates air pressure by compensating for fluctuations in air supply and variation in cfm requirements of pneumatic equipment . . . automatically lubricates airoperated equipment by providing the correct amount of misted oil to the air stream. Bellows Lubri-Air Control Units are available in 1/4", 3/8", 1/2", 3/4" and 1" sizes.

655C-3

Bellows

DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

For more data circle 354 on Postpaid Card

Free Bulletin LA-20 gives complete infor-

mation. Write for

your copy today. Ad-

1061, Valvair,

Ohio

dress Dept. MMS

Bellows.

Akron 9



YOUR PRODUCT COSTS LESS AT THE END OF THE LINE

when you start with B&W Job-Matched Mechanical Tubing

Here's how B&W makes unit cost savings possible on machined, formed and structural parts. First, B&W gives you unbiased assistance in choosing the proper stainless, alloy or carbon steel grade of seamless or welded tubing. Uniform physical and mechanical properties—hot or cold finishing—standard or special tolerances—proper heat treatment—are then built into the tube depending on your fabricating procedures and end-use application. When B&W Job-Matched Mechanical Tubing goes on the line you can be sure

it's as close as possible to the finished part. It also has optimum machinability or formability. The result: some fabricating operations are eliminated. Others are speeded up. Your end product comes off the line at maximum rate of output—at minimum unit cost.

Make good fabricating sense? To find out more, contact your local B&W District Sales Office or Steel Service Center. Meanwhile, write for Bulletin TB-430. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pennsylvania.



THE BABCOCK & WILCOX COMPANY

TUBULAR PRODUCTS DIVISION

TA-1012-M

Seamless and welded tubular products, solid extrusions, rolled rings, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels and special metals

For more data cirice 355 on Postpaid Card

October, 1961

MODERN MACHINE SHOP

48a





ARE YOUR BEST INVESTMENT

CLEVELAND Tools help you reduce your tooling costs, because ...

- . Their built-in quality lowers your manufacturing costs.
- . You can get CLEVELAND QUALITY in a wide range of cutting tools.
- Fast delivery from local distributors' stocks, to maintain your production schedules.

PLUS the added benefits of "Teamwork Tooling", whereby the talents of many people are combined to effectively reduce your costs. "Teamwork Tooling" includes not only our engineering skills and modern manufacturing facilities, but also the capable services of our Suppliers, Stockrooms, Service Representatives and Distributors.

THE CLEVELAND TWIST DRILL CO.

Cleveland 1, Ohio



C. 1961 All Rights Reserved

For more data circle 356 on Postpaid Card

48b MODERN MACHINE SHOP

October, 1961



IN YOUR THREADING OPERATIONS

BAY STATE Quality Taps, Dies and Gages will produce your threaded parts at lower cost, because . . .

- Skillfully engineered and manufactured to give you more threaded parts per tool.
- · A complete line of Taps, Dies and Gages for all threading operations.
- · Prompt service from your local Industrial Supply Distributor.

PLUS our trained Service Representatives operating out of strategically located stockrooms to help you solve your thread cutting and gaging problems.

BAY STATE TAP AND DIE CO.

Mansfield, Mass.

Subsidiary of The Cleveland Twist Drill Co.



COTTING TOOLS

BEST SERVICE



THROUGH YOUR LOCAL DISTRIBUTOR

C 1961 All Rights Reserved

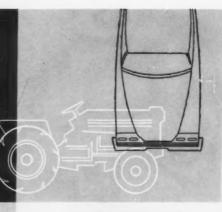
For more data circle 357 on Postpaid Card

October, 1961

MODERN MACHINE SHOP

48c





CLEEREMAN

SERIES A, AUTOMATIC CYCLE,

DRILLING AND TAPPING MACHINES

To meet the needs of industry for precision parts for quality products, Cleereman has developed a full line of Drilling and Tapping Machines.

The latest developments of the Series "A" are Special Purpose Arrangements for small lots or production runs.

- Two or more columns can be mounted on a special base.
- High precision production through use of rotary type index tables.
- The building block concept provides lew cost initial investment and basic machine elements for changeover to new and different piece parts.
- Complete automatic cycle push button operation at all stations.
- Ease of set-up, pick-off change gears, broad range of speeds, feeds and tap leads.

PHONE, WIRE, OR WRITE

CLEEREMAN MACHINE TOOL CORP.

General Distributor: The Jackson-Fotsch Co. 7354 W. Lawrence Avenue, Chicago 31, Illinois Factory: Green Bay, Wisconsin

For more data circle 358 on Postpaid Card

Special Purpose Series "A" with Retary Type Index Table.

Aluminum Problems?

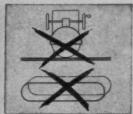
See how the LAPMASTER can lick 'em...



CLAMPINO ELIMINATED. Aluminum, magnesium and all non-ferrous metals can't take clamping without warp or distortion. The Lapmaster eliminates this serious problem because flat surfaces are lapped in a free, unclamped state. Flatness checks show that the Lapmaster consistently produces surfaces to extremely close tolerances... even irregularly shaped parts, like those above, pass the most rigid inspection for flatness.



"AS-CAST" WARPAGE REMOVED FAST. Lapmasters quickly rectify "as-cast" warpage on flat surfaces of non-ferrous metal parts. Lapping produces the true, flat reference plane desired for subsequent machining. In other instances where parts become distorted due to clamping and chucking operations, a short, follow-up cycle on a Lapmaster will return the surfaces to their original flat condition.



GRINDING PROBLEMS VANISM. There is no such thing as "lap plate loading". If you've tried grinding or belt sanding aluminum or magnesium, you know how fast the wheels load . . how difficult and costly it is to prevent surface gouging, ripping or tearing. But with the Lapmaster method of stock removal, you never face such problems. Instead, you get uniform accuracy and a scratch-free finish, pieceafter-piece.



NO MORE BURRS. After lapping on a Lapmaster, burrs just don't exist. Finger testing proves it every time. Lapping eliminates the expense of subsequent hand deburring operations and helps reduce inspection costs. This advantage is especially important in the finishing of pump, compressor or engine parts or on parts incorporating "O" ring groove on the face.



FAST SYOCK REMOVAL. Lapping of non-ferrous metals on a Lapmaster is a finishing method that saves time and money for hundreds of manufacturers. Stock removal rates are high. Other methods requiring expensive tooling still cannot match the accuracy of lapping. And Lapmasters do it right the first time, every time.



PERFECTLY MATED SURFACES. In many cases, Lapmasters eliminate difficult gasketing problems by lapping mating surfaces to microinch finishes of 2 to 3 AA, to flatness within one light band (.0000116") or less and parallelity of exacting tolerances. The Lapmaster, for example, produces mating surfaces on aluminum transmission parts that will hold oil at 200 pai. Its uniform accuracy also eliminates selective assembly.



Write for the complete Lapmaster catalog of facts and money-saving ideas.

A product of

Crane Packing Company

6418 GAKTON STREET * MORTON GROVE, ILLINOIS (Chicago Suburbi In Canada: Crane Packing Company, Ltd., Hamilton, Ont. In England: Payne Products International, Slough Buchs.

For more data circle 359 on Postpaid Card

The Payoff is Performance



G-E Man-Made diamond tackles high grinding costs

Increases wheel life 80% for Deane Carbide Products Co.







Grinding wheels containing General Electric Man-Made diamond outperform natural diamond wheels in on-the-job applications, time after time, day after day.

Here's just one typical example of what grinding wheel users have discovered:

Deane Carbide Products Company, in surface grinding tungsten carbide die blocks, found that wheels with G-E Man-Made diamond remove .24038 cubic inches of carbide per .001inch of wheel wear compared to only .13354 cubic inches for natural diamond with the

same wheel wear. A wheel life superiority of 80%, General Electric Man-Made diamond over natural! And wheels with G-E Man-Made diamond result in a 17% more efficient cutting rate — removing .1717 cubic inches of carbide per hour compared to .1467 cubic inches for natural diamond

Are you looking for longer wheel life, increased output, greater efficiency, lower costs? Then prove this superiority for yourself. Put wheels containing G-E Man-Made diamond to work in your shop. You'll find, as many others have, the payoff is performance.

METALLURGICAL PRODUCTS DEPARTMENT

GENERAL & ELECTRIC

11109 E. 8 MILE AVE., DETROIT 32, MICHIGAN

CARBOLOY® CEMENTED CARBIDES . MAN-MADE DIAMOND . MAGNETIC MATERIALS . THERMISTORS . THYRITE® . VACUUM-MELTED ALLOYS

For more data circle 360 on Postpaid Card





... that's how quick and easy it is with the Bausch & Lomb DR-25B Optical Gage!

Takes just seconds to get direct readings to .0001"... depth, thickness, height, diameter, taper. You read in "tenths" from 0" to 3" on a bright, magnified scale... with such extreme accuracy (0.000025") that masters or set gages are unnecessary. Specially calibrated to normal shop temperatures with easy conversion charts for any temperature fluctuation. Here's today's fastest, easiest way to get highest accuracy readings . . .

with job-proved savings of as much as 85% in gaging time...for only \$875! See it, compare it, in a free-onthe-job demonstration.

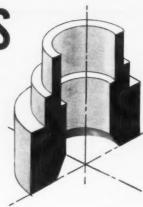
BAUSCH & LOMB

Made in America, to the world's highest standards.

Dist	ributes	in U.S	.A. th	rough	the Do	ALL	Company
		& LOI					. Y.
	the I part.		3 with	no o	bliga		ation of on my
_	ME			nog L			
-		***********					
				ZONE	ST	ATE	

For more data circle 361 on Postpaid Card

YOUR ANSWERS TO THIS QUIZ CAN UNCOVER NEW PROFITS



1. Do you grind holes 4" in diameter and larger?

2. Do you grind taper holes or mating parts?

3. Do you grind on irregular shaped work?

4. Do you grind O.D. or I.D. shoulders, offsets, undercuts?

5. Do you grind pieces requiring extreme concentricity?

6. Do you require a 5 micro-inch or better finish?

7. Do some of your grinding jobs require many setups?

If you answer yes to three or more questions, a Springfield vertical universal grinder can save time and money in your plant. Write today for your free, informative copy of Bulletin 210-M.

THE SPRINGFIELD MACHINE TOOL CO., SPRINGFIELD, OHIO





For more data circle 362 on Postpaid Card



These actual case histories show how 41½ hours of machine shop production by the usual method were reduced to $5\frac{1}{2}$ hours with SINGER Numerical Control:

JOB

- (1) Drill Jig for Terminal Board, Jig Bore all Holes
- (2) Jig Bore 38 Holes in each of Three Chassis
- (3) Nine Motor Housings
 - a. Layout 6 holes and drill on faces of housings
 - b. Layout 7 holes and drill on outside diameters of housings

USUAL METHOD

8 Hours

- 3 Hours/10 Min. x 3 Pieces Total 9½ Hours
- 1 Hour/10 Min. x 9 Pieces Total 10½ Hours
- 1 Hour/30 Min. x 9 Pieces Total 13½ Hours

411/2 Hours

SINGER NUMERICAL CONTROL

2 Hours

- | Total | Tota

51/2 Hours

MOST IMPORTANT, you'll find that SINGER Numerical Control will pay for itself in a very short period of time. For full details, write to the address below:

Grand Total:



DIEHL MANUFACTURING COMPANY

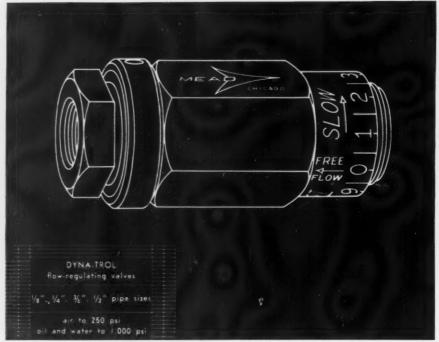
SUBSIDIARY OF THE SINGER MANUFACTURING COMPANY

Finderne Plant, Semerville, New Jerse

To Transmit of THE SHIGHT ANNUAUTHORIS COMPANY

10011 01011 01011

For more data circle 363 on Postpaid Card



PROBLEM® how to replace a 1/4" valve with a less-costly 1/8" valve (and get extra precision in low-flow ranges)

SOLUTION: NEW MEAD DYNA-TROL VALVE



Check these design advantages of the new MEAD DYNA-TROL flow-regulating valve:

- Adjusting sleeve easily rotated by hand — locks to any setting and cannot be accidentally removed from valve body
- Calibrated sleeve records settings for future reference
- Knife-edge variable orifice reduces flow distortion caused by viscosity changes in working medium
- No internal springs to cause malfunction
- · All parts rust-preof
- Wide operating range: -40° F. to +250° F.

Small, economical MEAD DYNA-TROL flow-regulating valves can replace more costly valves of larger pipe size. Reason: Internal design permits pneumatic or hydraulic flow equal to full pipe area in both directions. The first 360° turn of the adjusting sleeve increases flow from zero to about 10% of potential—a new measure of precision in low-flow ranges. Successive turns accurately reach 100% of pipe capacity. To cut costs and give exacting control to piston speeds, specify MEAD DYNA-TROL valves to solve your flow regulating problems. For information on quick delivery, write to MEAD today.



A DIVISION OF MEAD SPECIALTIES CO. 4114 N. KNOX AVE., Dopt. 2571 CHICAGO 41, ILL.

ASK YOUR MEAD MAN for more dollar-saving automation ideas
For more data circle 364 on Postpaid Card



New GORTON VARIABLE SPEED HEAD Model 1-22 Mastermil

- The ideal head for milling high tensile strength alloys with maximum cutter efficiency.
- Remarkably smooth spindle operation throughout entire speed range from 65 to 4,600 RPM . . . insured by unison-mechanical change of pulley diameters, with positive control.
- Guaranteed high precision spindle of interchangeable self-contained design.
- · Direct reading spindle speed dial provides fast speed selections.
- · Maximum torque in low speeds through back gear design.
- Dial-type down feed—infinitely variable .250 to 4.000 inches per minute with built-in over-running clutch for feeding against positive stop.
- · Traditional GORTON quality in every detail.



Write for Bulletin No. 2699 for complete description of new variable speed head and Gorton Mastermil.





BEORBE **EURTUN** MACHINE CO.

Milling, Die Sinking, Profiling und Engraving Machines with Manual Hydraulic, Efectro Hydraulic or Numerical Guidance Systems,
SINCE 1893 Special Machines and Automated Transfer or Indexing Machines, Cutting Tools and accessories. Defense and special products

For more data circle 365 on Postpaid Card

NOW

PRE-PACKAGED DRILL ROD ...
PRICED BY THE PIECE!



Firth Sterling

NOW... EASIER TO HANDLE—packaged in durable tubes and/or boxes which are clearly marked by quantity, grade, size.

NOW... EASIER TO STOCK—tubes have easy-off cap, cartons have jaw-opening end to permit easy removal of rods (inventory keeping is easy—just mark on the package!).

NOW...NO RUST, NO DIRT—stocked in dust-proof containers, rods remain clean; special VPI paper inside the package prevents rust and corrosion.

NOW...PRODUCTION COST ACCOUNTING SIM-PLIFIED—you no longer have to convert pound-prices into piece-prices in estimating, purchasing, cost accounting...it's done for you!

PRE-PACKAGED FIRTH STERLING POLISHED DRILL ROD AVAILABLE IN STANDARD 3' LENGTHS: COMMERCIAL - INVARO (oil hardening) - STERLING (water hardening) - STERLING "V" (water hardening)

SHIPPING PRE-PAID . . . ONE INVOICE . . . DELIVERY GUARANTEED!

ORDER NOW FROM YOUR FIRTH STERLING DISTRIBUTOR

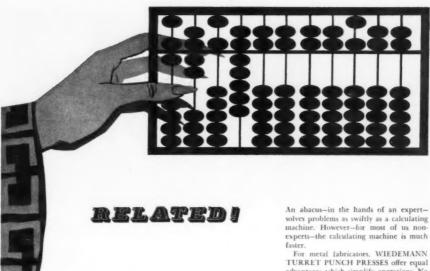


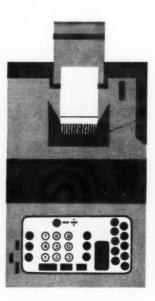
3113 Forces Ave. Pittsburgh 30. Pa Offices and warehouses in principal cities

in principal cities

For more data circle 366 on Postpaid Card

56





For metal fabricators, WIEDEMANN TURRET PUNCH PRESSES offer equal advantages which simplify operations. No other method of producing holes, notches and other openings in sheet metal or plate can compare with the WIEDEMANN for speed, flexibility and economy on short run production.

With a minimum of instruction, an inexperienced man becomes an expert on a WIEDEMANN. The output of this team exceeds by several times the production of trained oldtimers using other methods.

This is but one of the many reasons why America's metal fabricators are switching to WIEDEMANN—the method that cuts short run piercing costs up to 90%. For the full story on the many advantages of the "WIEDEMANN METHOD", write today, sending in drawings of your work for free time study and recommendations.



A-15 WIEDEMATIC
Tape-controlled Turret Punch Press

WIEDEMARK

WIEDEMANN MACHINE COMPANY Dept. MM10,Gulph Road • King of Prussia, Pa.

For more data circle 367 on Postpaid Card

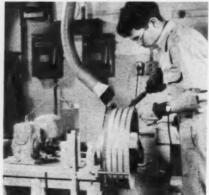




WHAT "GOES INTO" A BLANCHARD WHEEL?

Quality . . . Care . . . Experience. That's the "formula" for Blanchard Wheels and Segments. Working with the finest raw materials obtainable, skilled technicians supervise every manufacturing step from batching to banding. And each operation is based on years of development work. It's your assurance of the best in silicate, resinoid, and vitrified bonded wheels and segments . . . the best for your Blanchard Surface Grinder. Check your Blanchard Representative. And send for: "The Art of Blanchard Surface Grinding" (4th printing).

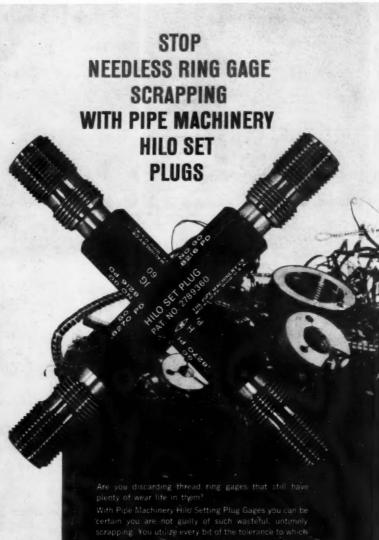




PUT IT ON THE BLANCHARD THE BLANCHARD MACHINE COMPANY

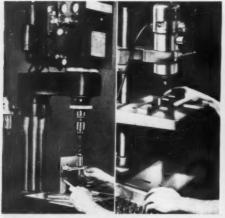
64 State Street, Cambridge 39, Massachusetts

For more data circle 368 on Postpaid Card

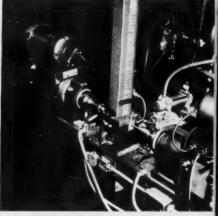


HINERY COMPANY 29100 takeland Boulevard . Wickliffe, Ohio . Greater Cleveland

For more data circle 369 on Postpaid Card



general purpose machining
Use any Dumore Drilling Tool for a continuous
job...tapping, drilling, etc....in one set-up.



automated set-up
Combine one or several Dumore Drilling Tools
with automatic workpiece feeding and holding
devices for specific operations.

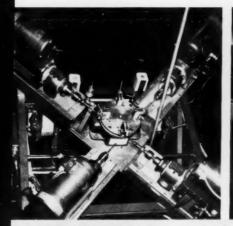
UNLIMITED MACHINING VERSATILITY

for holes from .001 to 3/8"

You can tap, drill, ream, chamfer, spotface, center, deburr and do related work in general purpose, automated set-up, multiple machining and changing set-ups...at lower cost.

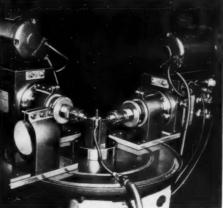


YOUR DUMORE DISTRIBUTOR HAS COMPLETE STOCKS FOR FAST DELIVERY



multiple machining

Combine several Dumore Drilling Tools in one set-up to perform several different operations, at the same time or in sequence.



changing set-ups

Move the same Dumore Drilling Tool to several different set-ups to do specific jobs.

PORTABLE, PRECISION DRILLING and TAPPING TOOLS



"hi-speed" units

800 to 15,000 rpm speeds for holes from .020" to 1/4", 2 models. From



"drill-n-tap" units

Drills or taps automatically at the flip of a switch. Drilling No. 60 to 3/8', tapping 0-80 to 1/2-13. (in mild steel). From \$907.50"



drill units

Automatic drilling units. Built-in power and controls. 2 models Drills No. 60 to 3/8" (in mild steel). From \$595°



drill heads

No. 80 to 5/32" drill capacity-built-in power for automatic operation. 2 models. From \$237.50*



micro-drill

Drills small holes from .001" without special operators. A miniature niature jig borer, \$625°



sensitive drill press No. 80 to 1/8" drill capacity. Foot switch op-eration. \$102.50*

*FOB Racine



drill speeder

Converts standard drill press or lathe to high speed driller. Fits into chuck, supplies its own power. No 80 to 1/8" capacity. \$47.50"



and Dumore engineered production tools and accessories including com-plete automatic drill presses and fixtures.

YOU CAN DO MORE WITH

PORTABLE PRECISION METALWORKING

THE DUMORE COMPANY 1300 Seventeenth Street, Racine, Wisconsin

HI-SPEED DRILL UNITS . DRILL-N-TAP UNITS . DRILL UNITS . DRILL HEADS . MICRO-DRILLS . DRILL GRINDERS . TOOL POST GRINDERS . HAND GRINDERS . FLEX-SHAFT TOOLS . QUILLS AND ACCESSORIES . VERSA-MIL UNITS



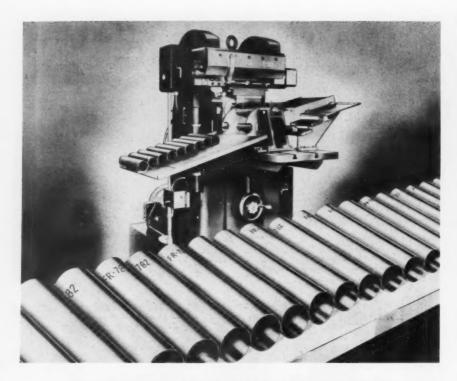
When you have a need for erector-type components for special machines...machining heads, feed tables, machine beds...contact our subsidiary Master Manufacturing Company, Hutchinson, Kansas.

SEE HIM FOR A DEMONSTRATION...OR WRITE FOR BULLETIN D-60-C

For more data circle 370 on Postpaid Card

October, 1961

MODERN MACHINE SHOP



AUTOMATED MARKING EQUIPMENT

EXAMPLE: OVER 3,000 TUBES PER HOUR

Here's a tough marking job—thin walled tubes would collapse under normal marking pressure. The problem was solved using a spider and reciprocating arbor type feed in a Model 175... marking at a rate of 3,000 per hour.

Production marking of parts—any size or shape—is a Schmidt specialty. Call in a Schmidt engineer! He can help you plan a cost saving marking system. Send today for Catalog No. 18.



IF IT'S WORTH MAKING, IT'S WORTH MARKING

GEO. T. SCHMIDT, INC.

Since 1895

Engraved Marking Tools • Nameplate Marking Equipment
Embossing Dies • Special and General Purpose Marking Machines

1806 W. Belle Plaine • Chicago 13, Illinois • Phone EA 7-0300 For more data circle 371 on Postpaid Card



DOWERTHEN COPYMATIC

SQUARE BROACHES .

ROUND

0

RODUCTIO

. MINUTE MAN . KEYWAY BROACH KITS BASES MINUTE MAN

BITS

Al AGONA

We cut

Keyway cutting costs 75% with a Minute Man KEYWAY BROACH KIT

Before Minute Man we had to set up big machine tools to cut keyways. No more. With the Minute Man Keyway Broach Kit, and an arbor Broach Kit, and an arbor press, we cut keyways by hand in one minute for as little as one cent a keyway. Any standard size from 1/16" to 1" in any bore from 1/4" to 3"

Special and stock square, round, hexagonal and Production Type Keyway Broaches will also save time and money. Send the coupon for com-(B) plete details.

mmoresoesessessesses

- (A) SQUARE BROACHES 1/8" to 1" square holes
- (B) HEXAGON BROACHES 1/4" to 1/4" hexagon holes
- (C) ROUND BROACHES 1/4" to 1" round holes

The duMont Corp., Greenfield, Mass.

MAIL FREE BROACH CATALOG AND PRICE LIST S describing Square, Hexagon Broaches, Production Type Keyway Broaches and Keyway Broach Kits to

Name	ø	e					0			4	0	0		0	0	0	0	0	0		
Compan																					

duMont

For more data circle 373 on Postpaid Card

Meetings

Important Meeting Dates

OCTOBER 10-12 . National Electronics Conference Inc., Annual Convention and Exhibit, Sherman Hotel, Chicago. Conference headquarters: 228 N. LaSalle St., Room 2104, Chicago, Illinois.

OCTOBER 18-20 • Gray Iron Founders' Society Inc., Annual Meeting, Royal York Hotel, Toronto, Ont. Society headquarters: 930 National City-E. 6th Bldg., Cleveland 14, Ohio.

OCTOBER 18-20 . Packaging Institute, 23rd Annual Forum, Biltmore Hotel, New York. Institute headquarters: 342 Madison Ave., New York 17, New York.

OCTOBER 19-21 > Foundry Equipment Manufacturers Association Inc., Annual Meeting, Greenbrier Hotel, White Sulphur Springs, W. Va. Association head-quarters: Suite 202, 1 Thomas Circle, Washington, D. C.

OCTOBER 23-25 • Abrasive Grain Association, Fall Meeting, Waldorf-Astoria Hotel, New York City. Association headquarters: 2130 Keith Bldg., Cleveland 15, Ohio.

OCTOBER 23-27 • American Society for Metals, National Metal Congress and Exposition, Cobo Hall, Detroit. Society headquarters: Metals Park, Novelty, Ohio.

OCTOBER 25-29 • National Tool and Die Manufacturers Association, Annual Meeting, Huntington-Sheraton Hotel, Pasadena, Calif. Association headquarters: 907 Public Square Bldg., Cleveland, Ohio.

OCTOBER 31-NOVEMBER 1 . National Metal Trades Association, Biennial Meeting, Hotel Commodore, New York. Association headquarters: 222 W. Adams St., Chicago 6, Illinois.

NOVEMBER 1-3 . Investment Casting Institute, Annual Meeting, North Park Hotel, Chicago. Institute headquarters: 27 E. Monroee St., Chicago 3, Illinois. For more data circle 372

POWERTURN COPYMATIC

...quick-change artist!

One piece

Precision

Job lot

Quick Set-up

Production run Minimum Cost



POWERTURN 90° COPYMATIC CARRIAGE You've got a good thing going for you when you install a POWERTURN COPYMATIC. Choose engine lathe operation or instantly change over to tracer controlled duplication. Lodge & Shipley offers you a choice of 45° or 90° hydraulic tracing slides. No awkward projections, built for efficiency and operator convenience.

Whatever your choice, Lodge & Shipley has both. Write for literature describing each type of POWERTURN COPYMATIC...fine lathes with records such as: "saving \$14,000 per year"..."production increased 300%"..."saves 85% of former time."

The Lodge & Shipley Co., 3058 Colerain Ave., Cincinnati 25, Ohio.

For more data circle 374 on Postpaid Card

45° COPYMATIC

CARRIAGE

your Lodge-ical choice in lathes...

Lodge & Shipley

64 MODERN MACHINE SHOP

October, 1961

NEW W

from

NORTO





SDI50-KIDOB56-1/8

103805





with the first really new bond in all diamond wheel history!

...B-56, an unparalleled advancement for all carbide grinding ...wet and dry

Since Norton Company developed the first diamond wheels for industry in 1929 it has been the leader in diamond wheel progress — first the resinoid bond, then the metal and vitrified bonds.

Now comes another "first" from Norton, a brand-new bond, the B-56, an outstanding development combining greater productivity and economy for either wet or dry carbide grinding in ONE bond — providing the finest diamond wheels, the Dia-Crown line, ever produced for tool sharpening, die grinding and all other carbide toolroom or production jobs.

In test after test on the widest range of carbide grinding, wet and dry, in customers' plants, Norton Dia-Crown B-56 wheels have outperformed all other wheels with major results — per job — including the following:

- Increased volume of carbide removed, per unit of time.
- Longer wheel life without sacrificing speed of cut.
- · More workpieces handled per wheel.
- Considerably lower wheel cost per cubic inch of carbide removed.

Believable? . . . It sure is! Look at these quotes from customer reports!

"Wheel was so good we could hardly believe it, and checked test results again . . . still showed 30% longer wheel life." "This wheel reduced grinding costs from 13¢ to 7¢ per tip."

"An extremely fine wheel. Cuts more carbide in a given time than any other wheel."

"Best wheel ever used. Will convert to this for all our diamond wheel operations."

That's what our customers say — and it's due to this entirely new Norton resinoid bond — a truly outstanding development. Norton Dia-Crown wheels with this new bond are available in all types and sizes for carbide grinding. Remember, too, that if two wheels of the same size and type have been required for wet and dry grinding — this ONE new wheel will now do both — wet or dry, reducing inventories and cutting costs.

Get complete facts on how this new Dia-Crown line of diamond wheels can improve your carbide grinding and save you time and money. See your Norton Man, a trained Abrasive Specialist, or your Norton Distributor. NORTON COMPANY, General Offices, Worcester 6, Mass. Plants and distributors around the world.



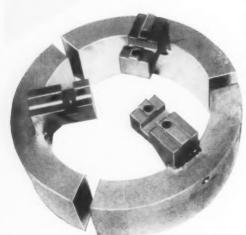
W-2025

 $Making\ better\ products\ .\ .\ .\ to\ make\ your\ products\ better\ normal products\ Abrasines\ -\ Stangaring\ Stress\ -\ Pressure\ Sensitive\ Tapes$

SOFT BLANK TOP JAWS

immediate delivery

STANDARDS



Soft Blank Top Jaws may be used on any chuck having master jaws. Both medium and heavy duty styles are carried in stock and made from 1020 steel.

BIG SAVINGS

Write today for prices

HURON MACHINE PRODUCTS, INC.

P. O. BOX 2274, DEARBORN, MICHIGAN

For more data circle 376 on Postpaid Card

MODERN MACHINE SHOP

October, 1961



For fast, economical cutting of flat metal shapes there are MODELS **Campbell Nibbling Machines**

with cutting capacities ranging from 3/32" mild steel for MODEL O machine to 1/2" mild steel for MODEL 530, in sheet sizes from 16" or less, to 72".

CAMPBELL NIBBLERS are making tremendous savings in time and money for hundreds of users in aircraft and other metal-working plants.

...in fast cutting of ferrous and nonferrous sheet metals or composition sheets.

... for moderate production runs or experimental development work.





Economical "throw-away" punch and die





Send for this catalog for complete information on this versatile production and experimental tool

• CAMPBELL NIBBLERS cut from 40 to 60 times faster than drilling or filing. A fast-moving punch (350 to 900 strokes per minute) operating over a die, nibbles out the design, taking a small "bite" with each stroke of the punch.

- ... for any and all kinds of shapes
- ... for either inside or outside cuts
- ... with no distortion of material-no internal strains -no invisible fractures-no burr
- ...with a "nibbled" edge that is sufficiently smooth to require very little finishing and sometimes none

CAMPBELL standard punches are made double end to double work life and halve the cost. Prices are so low (starting at 40c each, or 20c per working end) that new punches cost less than regrinding dull ones.

Here is a quick picture of CAMPBELL NIBBLING MACHINE Capacities

Campbell Nibbler Model#	Sheet	WORKING CAPACITY Sheet Thickness Mild Steel Alloy Steel	Strokes per Minute
		3/32"1/16"	
		3/16"1/8"	
		3/8"1/4"	
436	72"	3/8"1/4"	.350-525
530	60"	1/2"5/16"	.350-525
2524	48"	1/4"3/16"	.375-650
2536	72"	1/4"3/16"	.375-650

CAMPBELL NIBBLERS

Wilson Mechanical Instrument Division AMERICAN CHAIN & CABLE

Dept. 931, 230 Park Avenue, New York 17, N. Y.

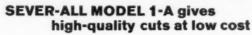
For more data circle 377 on Postpaid Card

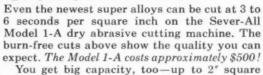






12 seconds per cut on this 2-inch steel bar!





solids, $3\frac{1}{2}$ " o.p. pipe and tubing, 3" angle iron and 4" channels. Wheel oscillation means cooler cutting, longer wheel life.

The Model 1-A is so easy to use, too. Wheel selection is simple—just two types of wheels for *all* Sever-All cutting jobs. Minimum set-up time required.

Immediate delivery from your Sever-All distributor. Write for his name—or for Bulletin DH-106.

SEVER-ALL CUTTING MACHINES

Allison-Campbell Division • American Chain & Cable Company, Inc.
931 Connecticut Avenue, Bridgeport 2, Conn.

For more data circle 379 on Postpaid Card

October, 1961

MODERN MACHINE SHOP

YOU CAN'T BUY MORE ACCURATE, LOWER-COST TRANSISTORIZED GAGES THAN TECHNI-RITE!



This dynamic new line of completely transistorized gages gives you two-millionths accuracy at unbelievable prices! Included are interchangeable gage heads and amplifiers for surface plate and height gage work, and bench inspection . . . surface finish gage, ultra-sensitive comparator for metrology use, cylindrical grinder control and transducer calibrator. Smaller, lighter, more versatile and dependable . . . Techni-Rite units are available off the shelf in 110 v AC or self-contained battery models. Priced as low as \$275. for a complete gaging system! Write for further information and prices.

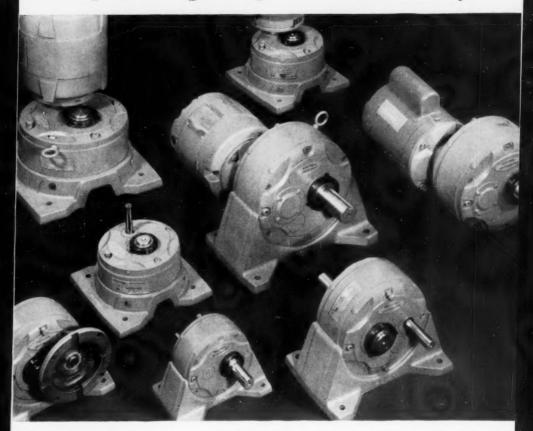
An Important New Name in Gaging and Recording

TECHNI-RITE ELECTRONICS, INC. . 49 Centerville Road, Warwick, R. I. . REgent 7-2000 . TWX WRWK 266

A few select representative territories are still available For more data circle 380 on Postpaid Card

BOSTON QUALITY ... OPTIMOUNT ADAPTABILITY

largest selection of standard models from stock simplifies design for speed reduction economy



Helical geared Ratiomotors and Reductors – single or double reduction.

For 1/6 to 15 HP drives. Horizontal or vertical base mounted, or shaft mounted.

680 mounting combinations from stock – meet any in-line need.

Furnished ready to install, by local Distributors.

Specify OPTIMOUNT. Save extra cost of special gearhead motors.
Save design time. See Catalog 57 for complete listings.

IN STOCK at your nearby DISTRIBUTOR



© Boston Gear Works, 1961 Quincy 71, Mass.

For more data circle 381 on Postpaid Card





MILLING
DRILLING
BORING
RIGHT ANGLE MILLING
SLOTTING
CHERRYING
FLY CUTTING
PROFILING
HYDRAULIC DUPLICATING

Bridgebort

"THE MOST FOR THE LEAST"

ATTACHMENTS and ACCESSORIES
to increase versatility

Milling, Drilling and Boring Attachments; Model "J" 1 H2; Model "M" 1/2 HP; Model "R" 1/2 HP and Model "C" 1/4 HP (Rigid Spindle)

Cherrying Attachment
Slotting Attachment
Power Feed
Measuring Attachment
(Rods and Indicators)
Optical Measuring
System (A recent
ddition to the
Bridgeport line)

Hydraulic Duplicators (1, 2 and 3 Dimension)

Synchro Trace (Fully Automatic, Single Dimension Duplicator)

Coolant Pump

Four-Inch Raising Block Seven-Inch Raising Block Cross Travel Stop Lights Right Angle Attachments Nos. 1, 2, 3 Quill Master Attachments Quill Master Right

Shell Mill Holders Nos. 1, 2, 3, Fly Cutters, FC-3, FC-4 Threaded Arbors

Angle Attachment

Stub Arbors End Mill Holders Spindle Adapters Vises Nos. 1 and 2

Vises Nos. 1 and 2 (Swivel and Plain) Profilers for Model "J" and "M" Heads

Boring Heads Nos. 1 and 2

Collets

Chucks (Jacobs and Albrecht)

Rotary Tables, 12" and 15"

Further details are available through your nearest dealer or from us direct.

Bridgeport MACHINES, INC.

Manufacturers of High Speed Milling Attachments and Turret Milling Machines

For more data circle 382 on Postpaid Card

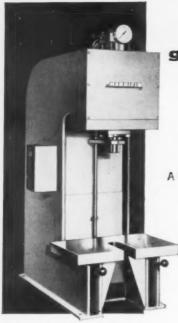


For more data circle 383 on Postpaid Card

October, 1961

MODERN MACHINE SHOP

75



get more production at lower cost with HANNIFIN "FD" PRESSES

A COMPLETELY NEW LINE OF HIGH-SPEED HYDRAULIC BENCH PRESSES

FAST DELIVERY—ALL THESE SIZES! 2, 3, 4, 5, 6, 8, 10, 12, 15, 20 and 25 TONS

HEAVY-DUTY OPEN-GAP PRODUCTION PRESSES

Our quantity production gives you highest quality at lowest cost.

THEY HAVE "EVERYTHING" ...

Dual Safety Hand Lever Controls
Dual Electric Push-Button Controls
Adjustable Stroke Control
Reverse on Pressure or Distance
Full Automatic Cycling
Hannifin High Speed Hydraulic Index Tables
Reciprocating Hydraulic Slide Feeds

USE THEM FOR ...

Assembly Operations
Riveting — Staking
Forming — Stamping
Trimming Die Castings
Trimming Plastics
Molding Semi-Conductors
Preforming — Compacting

MAY BE FLOOR MOUNTED-OPTIONAL, LOW-COST BASES AVAILABLE

Call in your nearby Hannifin man—he's a trained production analyst—to prove how you can do more at lower cost with Hannifin presses. Or, write for our new Bulletin 132A. It tells the whole story.



PARKER-HANNIFIN

HANNIFIN COMPANY DIVISION

565 South Wolf Road • Des Plaines, Illinois

PRELIMATIC AND HYDRAULIC SYSTEM COMPONENTS

EUROPEAN DIVISION . PARKER-HANNIFIN N. V. . SCHIPHOL . THE NETHERLANDS

For more data circle 384 on Postpaid Card

76 MODERN MACHINE SHOP

October, 1961

STOP Scraping by Hand use the

NEW BIAX SCRAPER

Production time reduced by 50%. Over 5,000 in use throughout the world. 22 points per square inch or more for class I fits.

The BIAX Scraper can be used for all scraping processes on sliding and locating surfaces. The stroke can be easily adjusted for every working cycle, material and work piece. The uniformity of the blade stroke guarantees a well finished scraping figure without subsequent figuring.

Available in electric, air and high frequency powered models.

Write for a free demonstration . . . in your plant.

Write for complete folder.
For more data circle 385 on Postpaid Card



Smooth and fine-scraping of a machine bed.



Scraping a run-in triangular bed.



Trimming of a rough-planed plate.



Scraping a run-in machine bed.



DAPRA CORP., 221 PITKIN STREET, EAST HARTFORD / CONN.

WISCONSIN Multiple

DRILL HEADS

Adjustable and Fixed-Spindle

Adjustable Spindle Heads have Dual Positioning Plates for fast, accurate set-ups that "stay put".

Positioning and Locking Templates are furnished for each bolt circle or hole pattern . . . to your exact specifications.

Half-hole Positioning Plates (1) make it easy to swing spindles into place quickly. Locking Plates (2), with full holes, are mounted on support posts to lock set-ups securely against shifting.

built to order.

Types

6 Capacity Ranges . . . from "Light Duty" to "Extra Heavy Duty". Standard Models have 2 to 8 spindles. Special Models

Send Print of Hole Pattern

for Estimate.



2. Locking Plate has full holes to hold spindles in place.

Wisconsin builds Standard Adjustable-Center Drill Heads, Special Fixed-Center Drill Heads. Lead Screw Tapping Units, Wis-Matic Universal Drill Tap Machines, Fixture Bases, and Special Drilling and Tapping Machines.



WISCONSIN DRILL HEAD CO.

4983 N. 124TH STREET BUTLER, WISCONSIN For more data circle 386 on Postpaid Card



Solidly built headstock features large over-size spindle and ball bearings. Rugged carriage has double-walled apron, large tool posts, and heavy-duty compound rest assembly. Extra-heavy duty tailstock provides rigid support for work. Wide,

machine-cut "Ductile Iron" change gears have as much as triple the strength of some cast iron gears, and tensile strength superior to most steel change gears. The $10'' \times 56''$ lathe bed has oversize ribs and balanced sections of even thickness to effectively neutralize internal stresses. Lathe's capacity (14%'') swing over bed, 9''

swing over saddle, 28" center distance) combined with ball bearing variable speed drive of 40-1400 rpm (no stopping to shift belts), makes Logan the best dollar value in the lathe field. Complete information on request.

rugged



Logan

LOGAN ENGINEERING CO., DEPT. D-1061 4901 W. Lawrence Ave., Chicago 30, III.

For more data circle 387 on Postpaid Card

October, 1961

MODERN MACHINE SHOP

79



FERRO-TIC is the only cemented carbide that is machinable and heat treatable. Fabrication is similar to tool steels; first conventional machining and then quench hardening for ultimate hardness. WOODHAVEN METAL STAMP-ING, like most FERRO-TIC users, make their own dies with existing equipment, thus, insuring quick service to their customers. In addition to much longer press runs, parts from FERRO-TIC dies are within closer tolerances and have better appearance. Since only superficial polishing is required to renew these dies, their actual production life is more than a hundred times that of tool steel. FERRO-TIC can be used for blanking, deep drawing, heading dies, arbors, core rods, wear parts, etc.



AGENTS THROUGHOUT THE U. S. A. WRITE FOR ILLUSTRATED BULLETIN \$10

Division of CHROMALLOY CORPORATION

169 Western Highway, West Nyack, N. Y. • ELmwood 8-5900

Chromalloy Division, West Nyack, New York Chromizing Corporation, Hawthorne, Calif. Propellex Chemical Division, Edwardsville, III. Elyria Foundry Division, Elyria, Ohio Shunk Manufacturing Co. Inc., Bucyrus, Ohio

*Reg. U. S. Trade Mark

For more data circle 388 on Postpaid Card

Ever see a magnetic chuck hold non-magnetic materials?

Magna-Vise

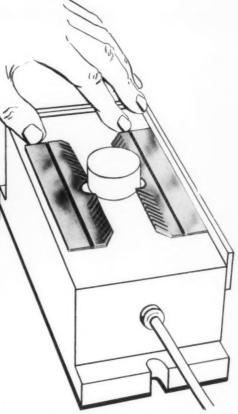
makes it easy!

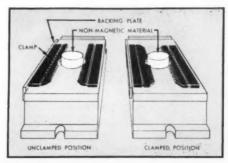
Helps you get more use from your magnetic chucks. Lets you use them to hold all kinds of non-magnetic materials. Eliminates cumbersome fixtures, reduces set-up time and costs.

Here's all you do: (1) Place Magna-Vise on de-energized chuck. (2) Place work-piece between Magna-Vise jaws. (3) Energize chuck. Magna-Vise jaws drawn down against chuck surface and sides of work-piece, hold it rigidly in place. (4) To remove piece, de-energize chuck.

Once you've used Magna-Vise you won't want to be without it. ORDER YOURS TODAY. Potent No. 2477297

Model	Length	Width Jaws	Thick	Price
6	63/8"	1%"	%4"	\$32.00
6A	63%"	1%"	1/16"	\$35.00
10	10"	1%"	%4"	\$42.00
14	14"	1%"	%4"	\$60.00





MAGNA-LOCK INC., Big Rapids, Mich.

For more data circle 389 on Postpaid Card



BURNERD GRIPTRU CHUCKS
3- and 6-Jaw, 4" to 12" Diameter
Chucks work to within .0002" at scroll
chuck speed.



BURNERD INDEPENDENT CHUCKS 4-Jaw, 31/4" to 28" Diameter



BURNERD UNIVERSAL CHUCKS 3- and 4-Jaw, 4" to 24" Diameter 3-Jaw chucks are available with either two-piece jaws or two sets of solid jaws.

When you buy

BURNERD

you save as much as

30%

Built to uncompromisingly high standards of accuracy . . .

Guaranteed against defects in material and workmanship for a period of *two* years . . .

Backed by the coast-to-coast sales and service organization of Clausing . . .

Burnerd chucks are still so economically priced that they save you 20%—even 30%. For example:

A 6" Universal chuck costs only \$78.50 — a 12", only \$180.00 A 6" 3-jaw GRIPTRU—which chucks duplicate parts to within .0002" — costs only \$96.00 14" four-jaw Independent is \$136.00!

Burnerd chucks are available for direct mounting to long taper or D-1 cam-lock spindles, or for backplate mounting.

SEND FOR

255

RIBNER

CLAUSING DIVISION

ATLAS PRESS COMPANY
10-212 N. PITCHER ST. . KALAMAZOO, MICH.

For more data circle 390 on Postpaid Card

82 MODERN MACHINE SHOP

October, 1961

These Can Save You **50%** in Time!

Revolutionary

BRIGHTBOY RUBBER-CUSHIONED

ABRASIVES



Simultaneously BURR • CLEAN • FINISH • POLISH

Work: Metals • Wood • Glass • Fiberglass • Laminated Materials • Some Plastics The exceptional new achievement in wider uses for abrasives REPLACES OLDER, COSTLIER METHODS

RUBBER & ABRASIVE COMBINE to produce a unique, time saving, single-operation action so exceptional that it must be seen to be believed. This action frequently serves as the final polish.

JOB-MATCHED, TIME & MONEY SAVING STOCK TEXTURES in wheels, sticks, rods, blocks and points are readily available and specifically suited to your machine and manual production operations.

Multi-use Brightboy stock numbers YOU OWE IT TO YOURconstitute the only complete, comprehensive line of rubber-bonded abrasives. You have extensive choicerange of Silicon Carbide and Aluminum Oxide abrasive grains impregnated in soft, semi-firm, firm and tough rubber binders.

SELF TO GET REVEALING PERFORMANCE DATA ON MULTI-USE BRIGHT-BOY. Write for the BRIGHTBOY CATALOG-MANUAL which details: Methods & Applications • Machine Speeds . Job-Matched Stock Numbers · Wheel Sizes · Complete range.





BRIGHTBOY INDUSTRIAL DIVISION WELDON ROBERTS RUBBER CO.

95 North 13th Street

America's Pioneer Manufacturer of Rubber-Bonded Abrasives

For more data circle 391 on Postpaid Card

October, 1961

MODERN MACHINE SHOP

Newark 7, N. J.





Galled and frozen shafts eliminated... a costly maintenance problem solved!

Twenty special, high temperature, recirculating fans installed on a furnace in a Missouri brick plant were a constant expense and source of trouble due to the failure of the water cooled, babbitted bearings.

Often, too, the shafts would gall and freeze in the bearing and shaft replacement was an expensive procedure.

Our Neiman Division bearing engineer suggested these bearings be replaced with anti-friction pillow blocks. Con-

version cost was only \$150 compared with \$175 to repour the babbitted bearing. Another plus was the elimination of the water cooling towers. After three years of service, no bearing failures have occurred and maintenance problems are eliminated!

You may not make brick, but if you have any kind of bearing problem — we are ready to help you, day or night. Just call the branch nearest you.

Providing bearing service BEARINGS, INC.

in the North >

Poinesville • Toledo • Youngstown • Zanesville • PENNSYLVANIA: Erie • Johnstown • Philadelphia • Pittsburgh • Reading • York DELAWARE: Wilmington . ILLINOIS: Neiman Bearings Co., E. St. Louis . INDIANA: Fort Wayne . Indianapolis . Muncie . Terre Haute MARYLAND: Baltimore - MISSOURI: Neiman Bearings Co., St. Louis - NEW JERSEY: Canden - Newark - NEW YORK: Balanrol Corp., Buffalo • OHIO: Akron • Canton • Cincinnati • Cleveland • Columbus • Dayton • Elyria • Hamilton • Lima • Lockland • Mansfield WEST VIRGINIA: Charleston . Huntington . Parkersburg . Wheeling

in the South DIXIE BEARINGS, INC.

ARKANSAS: Little Rock · FLORIDA: Jacksonville · GEORGIA: Atlanta · Augusta · KENTUCKY: Louisville · LOUISIANA: Beton Rouge New Orleans . N. CAROLINA: Asheville . Charlotte . Greensboro . S. CAROLINA: Greenville . TENNESSEE: Chattanooga . Kingsport Knoxville . Memphis . Nashville . VIRGINIA: Norfolk . Richmond . Roanoke

For more data circle 392 on Postpaid Card





SPADE DRILLS

MORE RANGE AT MUCH LOWER COST THAN TWIST DRILLS

FULLY ENGINEERED BLADE GRIND ...

Increased cross section at the cutting edge provides Greater Thermal Efficiency-Longer Tool Life than competitive blades.

FREER CUTTING ACTION

Exclusive Erickson method of grinding cutting angles gives Freer Cutting Action since end pressures are reduced.

"Heeling" eliminated.

EASY-TO-USE GRINDING FIXTURE...

Restores Original Factory Grind eliminating biggest obstacle to use of Spade

All cutting angles maintained during successive regrinds to original factory grind.

SPADE DRILL HOLDERS CORRECTLY ENGINEERED

"Funnel Effect" provided in flute design to speed chip escape.

Scientific distribution of coolant over whole cutting edge.

Send Your Drilling Problems to

ERICKSON TOOL COMPANY

34358 SOLON ROAD . SOLON, OHIO

COLLET CHUCKS * EXPANDING MANDRELS * AIR-OPERATED CHUCKS * FLOATING HOLDERS * TAP CHUCKS
* AUTOMATIC INDEXING * MASTER SPACES * DIAPPRACIA CHUCKS * PUSH-ON ARBODS * QUICK-CHANGE HOLDERS
* EXPANDING COLLETS * END-CLAMPING CHUCKS * AIR CYLINDERS (allowing stock to post through)
* EXPANDING JAW MANDRELS * SPECIAL HOLDING FIXTURES (including sear-holding) . BORING BARS . SPADE DRILLS . RECESSING TOOLS

For more data circle 393 on Postpaid Card



A Sunnen Honing Machine will handle any hole-sizing job shown here. It's the most versatile machine for all types of I.D. work...now used in thousands of shops.

It corrects all previous machining errors with minimum stock removal... and guarantees tolerances to .0001" with any desired surface finish.

You pay no premium for the extra precision . . . because Sunnen Honing is a fast, economical abrasive stock removal process.

It handles tandem bores, thin wall parts, blind holes, bores with ports or lands — in any size or shape part. No fixtures, no chucking or set up time.

1.D. range: .100"—2.625" with standard tooling. Built to order thru 4%".

SOLVE ALL OF THEM WITH ...

SUNNEN HONING
SUNNEN PRODUCTS COMPANY

7924 Manchester Ave. • St. Louis 17, Mo. Canadian Factory: Chatham, Ontario

ASK FOR FREE BOOKLET

X-SP-5075...showing 99 honing case histories covering all types of bore-sizing problems.

For more data circle 394 on Postpaid Card







"645" BETTER SIX WAYS

GREATER RANGE—

In EVERY category than ANY machine in its class • 25½" of ram travel • Spindle to table and spindle to column—Range greatly exceeds competitive machines, PLUS many other dimension advantages.

GREATER ACCURACY—

Ground lead screws • Hand scraped ways • Overin stays in one plane • Locks without distortion • cool room accuracy in manufacture of components.

GREATER VERSATILITY—

Head tilts 45° forward and back, rotates 360° on ram

Turret rotates 360° on column • Power assembly rotates 360° around spindle • Many other features.

• GREATER EFFICIENCY—

Convenient controls • 9 spindle speeds, 3 power spindle feeds (up or down) • 4-way head handles any compound work angle • Greater work area.

• GREATER DURABILITY-

Index quality throughout for long trouble-free life.

PROVEN ACCESSORIES AND EXTRA EQUIPMENT—

Ask for catalog and prices.

WRITE FOR YOUR COPIES OF 4-PAGE
DESCRIPTIVE BROCHURES PACKED
WITH FACTS ON NEW MODEL "645"
HEAVY DUTY "55" VERTICAL MILL
AND
MODEL "60" HORIZONTAL MILL.

INDEX

MACHINE COMPANY
544 N. MECHANIC ST.
PHONE ST 2-6737
JACKSON, MICHIGAN

For more data circle 395 on Postpaid Card

Precision Ground



SOLID CARBIDE TOOLS AND BURS

Job Applications

ATRAX LEADS IN **ELECTRONICS & SPACE AGE** SOLID CARBIDE TOOLING

NEW BROCHURE SHOWS

Small, Very small and Miniature TOOLS FOR ELECTRONICS CIRCUIT BOARD AND INSTRUMENTATION APPLICATIONS

ATRAX MICRO-DRILLS

Wire Sizes #40 through #80.

ATRAX DRILL BLANKS

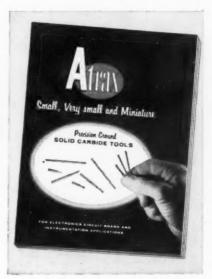
Wire Sizes #40 through #80.

ATRAX

From 1/32" to 1/8" diameter in

2 flute and 4 flute series.

This brochure is available free. It's a guide for selecting and ordering carbide tools for practically any operation on conventional materials as well as abrasive plastics, fibers, synthetics, laminates and exotic materials and alloys.



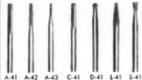
MINIATURE END MILLS

ATRAX MINIATURE HOLE **GRINDING BURS**

Hole finishes of 2 microinches or better can be expected using these burs.

ATRAX MIDGET BURS

All burs with 3/32" shanks, 11/4" overall.



ATRAX MINIATURE MICRO-REAMERS

In Fractional and Decimal Sizes. Recommended for all materials up to Rockwell C-56.

SEND FOR THIS NEW BROCHURE NOW!

It will help you to longer tool life, improved tolerances and greater production on hardto-cut materials.

THE ATRAX COMPANY
240 DAY STREET NEWINGTON 11, CONN.

Recommended for routing glass epoxy materials, Fiberglas, phenolics, bakelite, fiber and other synthetic materials.

ATRAX MINIATURE

STUB ROUTERS

For more data circle 396 on Postpaid Card

October, 1961

MODERN MACHINE SHOP



for fast, economical e production of shapes

Lockformer's

"Custom Shape" Roll

Forming Machines equip

your shop for production of special
shapes at speeds unmatched by any other
forming method! It takes only a single
pass to turn out even complex contours—
one operation by one semi-skilled operator, with

one operation by one semi-skilled operator production rates up to 100 fpm.

Single and Duplex Head Models are available with roll sets made to your exact specifications.

Write today for a complete set of Data Sheets showing how your shop can make special shapes at less cost with a Lockformer.

FREE DATA SHEETS

Yours for the asking . . . a complete set of Lockformer Data Sheets giving complete job details on a wide variety of parts. THE LOCKFORMER COMPANY, Dept. MS. 4615 W. Roosevelt

In Canada: Brown Boggs Foundry & Machine Co., Ltd., Hamilton, Ontario



Rd., Chicago 10, Illinois.

For more data circle 397 on Postpaid Card

53-pound grip on 1/32" thin strip...

B&S chuck demonstrates holding power sufficient for 8 hp grinding machine load - by supporting its own weight on 1" x 1/2" steel strip.

New **Brown & Sharpe** Micro-Mesh Chuck

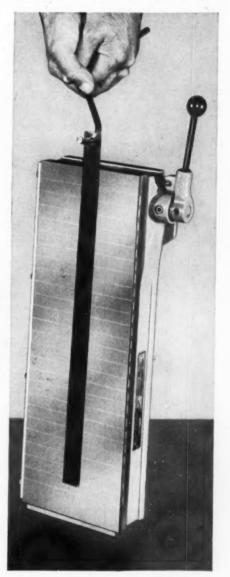
holds parts as thin as .001" for grinding!



Make big savings, grinding or machining small parts. Use the only magnetic chuck that grips work as thin as .001", tight enough for production cuts.

Close-spaced, barium-ferrite (ceramic-type) permanent magnets - no dead spots or weak zones - powerful, unbroken field, over the entire working surface.

Ask your B&S distributor for new Micro-Mesh Chucks! Brown & Sharpe Mfg. Co., Prov. 1, R. I.



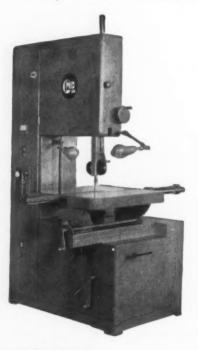


For more data circle 398 on Postpaid Card

GROB SPELLS THE DIFFERENCE IN BAND SAW MACHINES

The new GROB 24" universal band saw has all the famous GROB features:

Quality • Efficiency • Durability • Strength Utility . Low Maintenance . Reasonable Cost



- Speeds infinite from 35 12000 FPM covers both cold and hot
- Variable drive 3-speed transmission with precision rolled gears and splines fransmits 15 HP
- Hydraulic table feed

See the difference demonstrated in our dealers' showrooms

or

Write GROB INC. for complete specifications

GROB also manufactures a complete line of:



BUTT WELDERS FILING MACHINES GEAR ROLLING MACHINES

GRAFTON, WISCONSIN

For more data circle 399 on Postpaid Card





One Dual Purpose Power Chuck saves set-up time, cuts costs

The Skinner Dual Purpose Power Chuck is designed with four master jaws so that it may be used as a two- or three-jaw chuck. It is no longer necessary to pay for one chuck to machine round work, and an additional chuck to machine odd shapes and castings. Not only do you save the cost of an additional chuck, but you also save set-up time by changing jaws as necessary.

Dual purpose power chucks are available with adjustable, non-adjustable, or serrated jaws, in sizes 8" to 36". Like all heavy-duty Skinner power chucks, they are:

SIMPLE—Fewer moving parts

ACCURATE—Repeat within .001" on diameter

STRONG—Forged steel bodies

DURABLE—Carefully hardened wearing surfaces

Skinner power chucks are available for direct mounting on American Standard Spindles and for mounting on threaded spindle noses by means of separate adaptor plates.

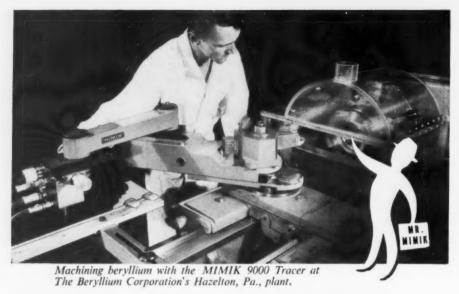
FOR MORE INFORMATION about power chucks and other major chuck developments, contact your Skinner Representative or write us at Department 170.



THE CREST OF QUALITY

SKINNER CHUCKS

SKINNER-HORTON CHUCK DIVISION
SKINNER PRECISION INDUSTRIES, INC. • NEW BRITAIN, CONNECTICUT, U.S.A.
For more data circle 400 on Postpaid Card



MIMIK" GIVES THE ANSWER

The question facing The Beryllium Corporation was how to speed production, cut high tooling costs and maintain close tolerance and finish in handling fast rising orders for hard-to-machine beryllium components. After a thorough study, aided by Mimik engineers, a decision was made to use Mimik Hydraulic Tracers on existing machine tools.

The Mimik Tracer, because of its extreme accuracy, versatility and complete interchangeability, gave The Beryllium Corporation added production capacity at a fraction of the capital cost required to install new machinery.

Changing production demands are met easily with the Mimik Tracer. The complete unit can be transferred in a matter of minutes from machine to machine regardless of make. The hydraulic slide action and super-sensitive 360° stylus control ensures that fine tolerances are consistently achieved.

Call or write for more information on the Mimik Tracer for engine and turret lathes, V.T.L.'s and milling machines. Request details of Mimik's unique guarantee of time and performance related to a specific job and machine.





MIMIK TRACERS INC., Buffalo, N.Y.

EAST: Mimik Tracers Inc., 3901 Union Rd., Buffalo, N.Y. CENTRAL: Bartsch Tool Corp., 3714 Oakton St., Skokie, Ill. WEST COAST: Allied Pacific Manufacturing Co., Compton, Cal. CANADA: Retor Developments Ltd., Galt, Ontario

Mimik-men are everywhere

For more data circle 401 on Postpaid Card

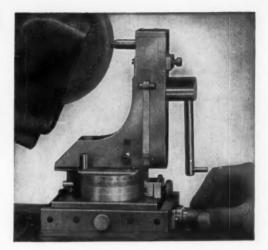
Tough Grinding Wheel Forms Dressed Easy as A, B, C

eliminate elaborate set-ups and operations

.0001" ACCURACY



dress two angles tangent to a radius



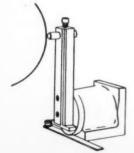
With the unique "Fluidmotion"

Dresser, you can dress two angles tangent to a radius — using one handle in one continuous motion.

Operation is so fast and simple that beginners can use them.

Adaptable to all type cylindrical and surface grinders.

- A. Obtain micrometer reading; add required convex radius or subtract required concave radius.
- B. Loosen jibs with wrench and "mike" over lower pins to reading obtained above.
- C. Tighten jib. Set stops for two angles. Ready for action.



Also available: "FORM MASTER" Dresser, capable of dressing any radii up to 12" convex, up to 15" concave.

See your industrial distributor or write for free literature.

J&S TOOL CO., INC.

871 DORSA AVE., LIVINGSTON, N. J.

WYman 2-3181

For more data circle 402 on Postpaid Card



... CONVERT YOUR DRILL PRESSES INTO PRECISION TURRET DRILLING MACHINES WITH...

QUADRILL 4 & 5 SPINDLE

TURRET DRILLING HEADS

- Save up to 70% in direct labor costs!
- · Fast manual indexing
- Quadrill Turret Heads make it possible for one drill press to do the
 work of 4 or 5 single spindle drills,
 with a corresponding saving in floor
 space . . . save up to 350% in capital
 equipment costs!
- Ideal for both long and short runs . . .
 fast setups . . . simple tooling. On
 long runs, savings in direct labor
 quickly returns cost of turret head.
- Models available for all standard drill presses.

Quadrill Turret Drilling Heads are proven in industry throughout the world for over 15 years . . . in companies such as Westinghouse, Chrysler, Bendix, General Electric, Douglas Aviation, Boeing and many others.

WRITE TODAY FOR BROCHURE

CHICAGO QUADRILL Company

1854 BUSSE HIGHWAY, DES PLAINES, ILL.

For more data circle 403 on Postpaid Card

(Continued from front cover) MORE ABOUT THE R-O TRAINING COURSE —

Send your R-O operator to Detroit. We will pick him up at the station or terminal, house him, feed him, give him two days (17 work hours) of expert instruction in set up, application and machine maintenance, grinding wheel selection and dressing techniques. Our charge is \$100.00. Write for available dates.

cost per piece drops when you put R-O to work



R-O will reduce your cost per piece by stretching cutting tool life. Give you more cuts per grind and more grinds per tool. R-O will reduce the cost of many tool room jobs such as producing punches by grinding hexes, shapes, etc. from the solid, faster (with better finish) and at less cost, including wheel wear, than conventional machining and grinding . . . Use the coupon.

RO	R-O Manufacturing Company 31171 Stephenson Highway Madison Heights, Michigan
UNIVERSAL FORM RELIEVING EQUIPMENT	Please forward the R-O catalog Firm
FIXTURE GRINDER	City Zone State

For more data circle 404 on Postpaid Card

Idle machines cost money. Rely on Jewel Brand abrasive belts to keep yours running



modern machine tools.

Machine tools effectively cut costs, increase efficiency and speed of production lines. But, the wrong abrasive belt can cause shutdowns and delays. Belt breakage, marred finishes and similar mishaps create costly production bottlenecks.

That's why experienced operators have come to rely on Jewel Brand abrasive belts. Jewel Brand belts are made in a variety of grains, bonds and backings to meet virtually every requirement. Jewel Brand's "Velvet Joints" permit an even flow of cutting surface, eliminating chattering and jumping.

Why don't you rely on Jewel Brand? Call your industrial distributor or write: Abrasive Products, Inc., South Braintree 85, Massachusetts.



COATED ABRASIVES

belts • rolls • sheets • discs • specialties For more data circle 405 on Postpaid Card



how much band saw mileage do you get?

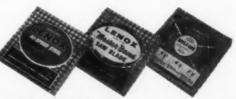
"Not enough!" This is the most frequent answer. Why? Our recent field survey shows wrong blade type or wrong specifications used in over 50% of band-saw cutting. Solution—Choose one of the three blades developed by LENOX to cut fast and efficiently at lower costs. These LENOX blades fill every cutting requirement. HIGH SPEED STEEL—For automatic cut-off equipment in full production work. Rapidly cuts most of the tougher steels. MASTER—BAND—Special alloy steel for standard equipment, cutting at semi-production or production rates. Also used on some automatic cut-off applications. DIEMASTER—Regular bands, cut-to-length or coil stock, for general purpose cutting. Interested in greater band-saw mileage? Get a true appraisal of your cutting needs by writing American Saw, Cutting Analysis Dept. Briefly describe your machine, materials cut, and type of operation. Recommendations and engineering help are furnished without obligation.

THE TOOLS IN THE PLAID BOX

LENOX

& MERICAN SAW & MEG. COMPANY

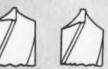
SPRINGFIELD 1, MASS.



For more data circle 406 on Postpaid Card

Set-up changes in seconds with the ...

AND ANY ANGLE IN BETWEEN



MIN. RELIEF MAX. RELIEF









CRANKSHAFT SPLIT POINT MODIFIED SPLIT POINT

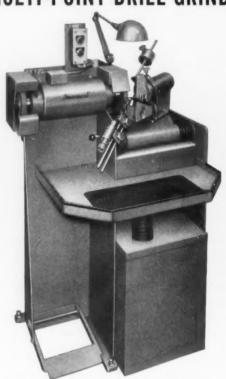




STEP

SUB-LAND

NEW Hammond MULTI-POINT DRILL GRINDER



NOW accurate grinding, simple adjustments, quick set-ups, and wide variety drill pointing can ALL be yours. Investigate the many distinctive, money saving features of this new, superior Hammond Drill Grinder. Request Bulletin 711 today.

Hammond Machinery Builders

1615 DOUGLAS AVE. KALA

KALAMAZOO, MICHIGAN

For more data circle 407 on Postpaid Card

Meet the "FIRST FAMILY" OF TOOL ROOM MACHINES



It's easy to know the Norton Family of Tool Room Machines. Their home is the modern tool room — and their scope is as broad as industry.

Above, you see them on the job — with each Norton machine adding its own special advantages to an efficient tool room operation. On the reverse side you'll find each member of the Norton family described in detail.

Specifically, the family includes a No. 200 Cutter and Tool Grinder; a Type S-3 Hydraulic Surface Grinder; a Type TS Hand Surface Grinder; a Type U-4 Universal Grinder; a Norton-G&E Shaper.

Separately or as a group, this "First Family" will bring top-ranking efficiency and economy to your own tool room — will help you maintain tools or produce jigs and fixtures that perform better . . . last longer.

For details on how Norton tool room machines can benefit your own operation see your Norton Man, a trained Machine Specialist. Or write to NORTON COMPANY, Machine Tool Division, Worcester 6, Mass,

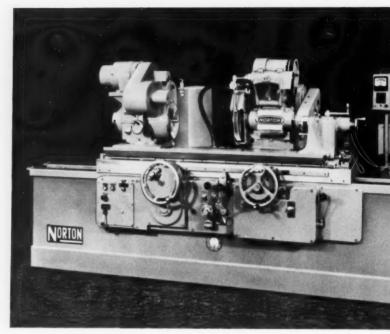
NORTON COMPANY, Machine Tool Division, Worcester 6, Mass. District Offices: Worcester, Hartford, Cleveland, Chicago, Detroit; In Canada: J. H. Ryder Machinery Co., Ltd., Toronto 5.



Making better products...to make your products better

"FIRST FAMILY" OF TOOL ROOM MACHINES

Universal Grinders



Featuring extra versatility extra fast setups

In a Norton Universal Grinder of any size — 10'', 12'', 14'', and you get a practically complete grinding department. Versatility ke the design, with quick, easy setups for external, internal, face and a wheelslide grinding — and with feature after feature increasing t range and cutting tool conservation costs. For example:

Extremely rapid chucking . . . quick changeover to live or dead s

operation . . . wide range of easily changed work speeds . . . indep wheel and feed settings for doing difficult jobs fast.

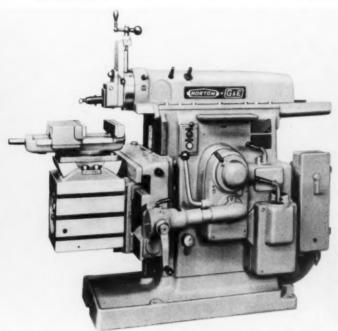
Available for use on all Norton Universal Grinders, the SWIVAI Dual Electric Indicator, shown here on a 14" Type U-4, eliminate and-try in establishing swivel table alignment. Ask your Norton Dis tor or write for Catalogs Nos. 170, 231 and 819.

*Trade Mark Reg. U. S. Pat. Off. and Foreign Countries

"FIRST FAMILY" OF TOOL ROOM MACHINES

G E Tool Room Shapers





The finest for generations

Backed by over a century of precision machine tool building, G&E Shapers feature 16 easily selected ram speeds, all-helical gear drive and many other developments with proved ability to cut time and costs.

G&E Tool Room Shapers, in 14" and 16" sizes, meet the constantly expanding field of shaper work and are outstanding for miscellaneous tool room and heavy die work. Convenience of controls and ruggedness of construction enable these machines to produce a wide range of variable flat

and compound angular surfaces.

Featured on Norton-G&E Shapers are: Hard chrome ram V-ways for constant accuracy and long life; crossrail and table slide design that provides 60% more bearing area and 50% greater rigidity; central controls are conveniently located for easy selection of the 16 ram speeds and 18 feeds; operator can adjust table and lock crossrail from control side; built-in horizontal and vertical rapid traverse to work table, with safety clutch, always operates in opposite direction to feed set. Ask your Norton-G&E Distributor or write for Catalog No. 2342.

Distribu-

and 18" -

y keynotes

nd angular

ng the job

ad spindle

idependent

VALIGN* nates cut-

chines

MODERNIZE with Norton Tool Room Machines

"FIRST FAMILY" OF TOOL ROOM MACHINES

No. 200 Cutter and Tool Grind





The wheel head TILTS 30° ... ORBITS 360°!

No time-wasting "cut and try" routine with the Norton No. 200 Cu and Tool Grinder . . . no more wrestling with tricky setups.

You can tilt the wheel head up to 15° above or below horizontal — swivel it through a full orbit of 360°. For the first time with a tilting whead, the Norton two-speed grinding wheel spindle provides the right spindle. for large or small wheels.

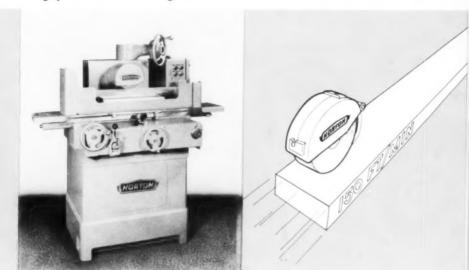
A wheel head scale provides quick direct reading of clearance angles, wheel head can be adjusted to eliminate many of the usual settings and t losses. And the table has a rugged guide bar for precision in tracking du

the toughest grinding jobs.

Also, the No. 200's extremely solid grinding action brings you excel finish on tool cutting edges, for longer lasting, better performing to Other features include: wheel-slide construction to eliminate possibility work overhang; antifriction elements under table to provide fluid ta motion; dual, centrally-located controls to simplify operation from position. Ask your Norton Distributor or write for Catalog No. 1371.

"FIRST FAMILY" OF TOOL ROOM MACHINES

nders Type S-3 Hydraulic Surface Grinders



FINISH FLAT FASTER!

Popular for a wide variety of tool room grinding, as well as long production runs, Norton Type S-3 Surface Grinders have given complete proof of their ability to finish smoother, faster, at lower cost.

Now, S-3 Grinders are available with a new maximum table speed of 150 fpm as standard. With higher table speeds, the stock removal rate is

Now, S-3 Grinders are available with a new maximum table speed of 150 fpm as standard. With higher table speeds, the stock removal rate is increased and the grinding time is reduced in proportion to the increase in stroking rate. The faster table speeds also provide extra cool grinding action that reduces heat damage to the work. Time and money are saved on every job.

Sizes of the S-3 Grinders are 6" x 18" and 8" x 24", both being equally fast, cool and accurate grinding. Taller workpieces... up to 15" on the 6" size and 1334" on the 8" size... are easily handled. Other job-proved features include a two-speed .0001" increment hand wheel, for accurate vertical speed and fast positioning, and contoured splash guards for better visibility. Ask your Norton Distributor or write for Catalog No. 1772.

0 Cutter

l — and ng wheel tht speed

gles. The and time g during

excellent of tools. bility of id table om any 371.

"FIRST FAMILY" OF TOOL ROOM MACHINES

Type TS Hand Surface Grinders





New...for your daily tool room jobs!

Available in sizes $6'' \times 12''$ and $10'' \times 16''$ the new Type TS Hand Surface Grinders bring you these typical Norton advantages for tool room machines:

Precision Performance. Wheel feed hand wheel has graduations of .0005" for fast, accurate positioning, plus a vernier scale graduated .0001" for precise grinding feeds. The long, rigid vertical slide and saddle provide greater support for moving parts, reduce vibration and improve finish. Accurate cross-feed is excellent for groove and shoulder grinding.

Easy Operation. Controls at working height are quickly accessible; design enables easy seated or standing operation. Handwheels eliminate cross-arm operation of table and cross slide. TS Grinders are the only machines of their type with hinged wheel guard for quick wheel change.

Overall Economy. Strengthened by many other simplified, long-lasting features for clean, uncluttered design which reduces maintenance costs. Ask your Norton Distributor or write for Catalog No. 388.

Printed in U.S.A.



machine F.O.B. Factory. A low cost leasing plan also available. shop

ADVERTISING REPRESENTATIVES

Granville M. Fillmore, Vice President, 60 E. 42nd St., New York 17, N. Y., Murray Hill 7-7390, Eastern New York State, Connecticut, Massachusetts, Rhode Island, Vermont, New Hampshire, Maine.

John M. Krings, Vice President, Room 211-A, 540 N. Michigan Ave., Chicago 11. Illinois. DElaware 7-5441. Western Michigan, Illinois, Wisconsin, Iowa, Minnesota, the Dakotas, Northern Indiana.

George E. Hay, 431 Main St., Cincinnati 2, Ohio, CHerry 1-5924. Western Pennsylvania, Western New York, Ohio, Kentucky, Southern Indiana.

Jeryl L. Marlatt, 1051 Brooklawn Rd., Birmingham, Mich., MIdwest 6-5935. Eastern Michigan. Northwestern Ohio.

Norman S. Rogers, 431 Main Street, Cincinnati 2, Ohio, CHerry 1-5924. Central Indiana.

Gene J. Schwarber, Advertising Manager, 431 Main Street, Cincinnati 2. Ohio. CHerry 1-5924. Missouri. Kansas.

Duncan W. Barton, 60 E. 42nd St., New York 17, N. Y., Murray Hill 7-7390, Eastern Pennsylvania, Central New York State, New Jersey, Maryland, Delaware, Washington, D. C., Long Island, Brooklyn.

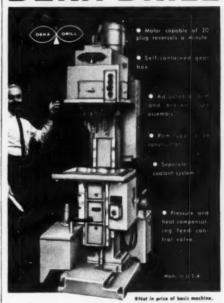
Charles F. Meister Company, 2252 West Beverly Blvd., Los Angeles 57, Calif., DUnkirk 8-7115, California, Oregon, Washington.

modern \$3,97500

DRILLS, TAPS, DWELLS, PERFORMS DEEP HOLE OPERATIONS AT THE FLICK OF A SWITCH!

DEKA+ DRILL is an automatic cycle hydraulically powered 14 spindle drilling and tapping machine that saves you time and money NOW. Costs 50% less . . . cuts set-up time in half . . . makes smaller runs profitable. Comparable in performance to any machine of its type. Suited for conventional or automated type jigs and fixtures. Component parts rated 20% to 25% beyond capacity. Free time and process studies available on request.

EKA.DRILL



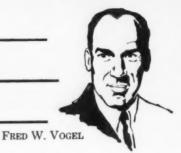
TYPICAL INSTALLATIONS: • REMINGTON RAND • MINNEAPOLIS HONEYWELL REGULATOR CO. • GENERAL TELEPHONE • GENERAL MOTORS CORP. . ALLEN BRADLEY CO. . SMITH CORONA MARCHANT INC. . AMPHENOL BORG ELECTRONICS CORP.

clip this coupon to your letterhead TODAY!

PRECISION

1305 S. Laramie Avenue Send Catalog 147.	& MFG. CO. OF ILLINOIS / Cicero 50, Illinois MMS-10 Have a representative call.
NAME	
FIRM	TITLE
ADDRESS	

OVER THE EDITOR'S DESK



WHO WILL BE NEXT?

In little trickles, it seems that information of the effects of foreign imports upon our economy has been gathered and published. Hardly anyone seems to feel it important enough to compile a total or overall figure which undoubtedly would reveal a startling situation. This observation is made in the light of the latest "trickle" sent to us by the U. S. Tool and Fine Steel Industry Committee, a group of fourteen steel producing companies. Speaking for the Committee, Mr. H. S. Potter, Vice President of Sales for The Carpenter Steel Company explains that had the tool steel and the products made from tool steel which were imported last year, been made in this country, the added production would have meant jobs for some 2,000 more workers, or longer work weeks for those now employed in the industry.

According to Mr. Potter, the loss of business because of imports is a matter of grave and growing concern to all of the 14 tool steel producing companies represented in the Committee. Tool steels imported from Europe, Japan and other nations are sold on a delivered basis at prices sharply lower than those prevailing in the United States. Mr. Potter has cited prices as much as 55 percent below some current American prices.

Certainly labor and price are important considerations but they are not as important as the long range strategic considerations. American producers cannot sell their products at the level of current import prices without operating at a loss. Under such circumstances, no company can stay in business for long, maintain present employment or provide future job opportunity. In essence, confronted by a national or international emergency, foreign supplies of tool steel would be severly curtailed if not cut off completely. Without the production of the small group of tool steel

EASY MATH. AT YOUR FINGER TIPS SAVE TIME AND MATERIAL

There are many layouts and setups that require calculation . . . your engineering cannot furnish all of them . . . if your workmen are using TRIG-EASY METHODS of calculating then you are "saving time and material" and avoiding trial and error methods. This is money in your pocket!

Using these equation charts you can calculate in higher mathematics. No previous training necessary.

PLANE ANGLES

Trig-Easy chart for plane angles and dimensions. (As shown).

50c POSTPAID



COMPOUND ANGLES

Trig-Easy chart with pocket manual over 140 pages, 60 drawings, 6 decimal trig-function table for compound angles and dimensions in machine set up, etc.





CURVEASY SET

Two charts with pocket manual of over 60 pages. 50 drawings for section areas and volumes of a circle sphere, ellipse and parabols; cylinders, cone and frustum.

Thousands of these charts used by draftsmen, tool, die and jig makers, machinists, students, inspectors, template makers and designers. EACH CHART HAS INSTRUCTIONS TO SHOW YOU HOW TO DO IT.

HANDY PACK COMPLETE!

THREE TRIG-EASY CHARTS for plane, spherical and compound angles. Complete with booklets in container.

\$3.00 POSTPAID



SPHERICAL ANGLES

Trig-Easy chart for spherical angles and dimensions.

\$1.75 POSTPAID \$2.50 POSTPAID 75c POSTPAID
CHARTS FOR ELECTRICAL ENGINEERS AND LOGARITHM TEXT BOOKS!

SOLD BY EUGENE DIETZGEN CO. NATIONALLY SINCE 1943
EVERYTHING FOR DRAFTING — SURVEYING — BLUEPRINTING

NEW YORK

PHILADELPHIA

PITTSBURGH

MILWAUKEE

DENVER

CHICAGO

NEW ORLEANS

WASHINGTON, D. C.

SAN FRANCISCO

KANSAS CITY, MO.

LOS ANGELES

OAKLAND, CALIF.

SEATTLE

CINCINNATI

and DIETZGEN dealers in all principal cities.

FOR MAIL ORDERS AND DESCRIPTIVE LITERATURE
WRITE THE MANUFACTURER BOX 587, DEPT. 15

PLEASE
NO Stamps
NO Stamps
LONG 11.00
PLEASE
NO Stamps
NO C.O.D. Under \$1.00

For more data circle 410 on Postpaid Card

Over the Editor's Desk . . .

producers in the United States, the entire metal manufacturing and fabricating effort would be effected disastrously.

And thus we would pass along another observation: Do not these tool and fine steel producers now find themselves in the same position as the optical, machine tool, precision instrument, and a host of other producers? And . . . when will some kind of action be taken to stem the growing menace to our productive capacity?

* * modern machine shop

WHAT ABOUT WAGES?

In a pamphlet titled "Facts About Japanese Wages," which we wish we had space to quote in its entirety, we read the following: "According to statistics of the International Labor Organization, Japanese cash wages in manufacturing industries averaged 26 cents per hour in 1957, compared to \$2.07 in the U.S., 65 cents in Great Britain, 51 cents in West Germany, 44 cents in France, and 33 cents in Italy. Clearly, wages in the U. S. are higher than anywhere else in the world. Excepting Canada, there is no country in which wages even begin to approach U. S. levels."

The foregoing figures, according to the pamphlet, are for basic cash wages and do not include fringe benefits received by Japanese workers which, even by American standards, sound most extraordinary. They include: year-end and summer bonuses amounting to 2 to 3 months pay, sometimes considerably more; family allowance; living cost allowance; length of service allowance; low-cost housing provided by employers; payment for transportation to and from work; meals at extremely low price; skill and job status premiums; age differential; clothing and necessities at large discounts; very low-cost vacations; welfare services paid for in part or in full by the employer, including free medical treatment and payment of virtually full salary indefinitely during illness; health and recreational facilities; health insurance, old age pension, unemployment and accident insurance, and finally a lump-sum retirement allowance which averages 31/2 years' salary after. 30 years employment, the cost of which is borne entirely by the employer.

We noted an apparent oversight in the presentation of the "Facts" for comparison . . . no listing of the important fringe and other benefits to which we U. S. workers have become accustomed.

You Can

Nozzie machined from leaded bronze 3/8" berstock. Length—1-3/16", Thread—1/4" 40 TPI, Large Hole—5/32", Sanaliest hole—1/32" diameter.

Costly Secondary Operations

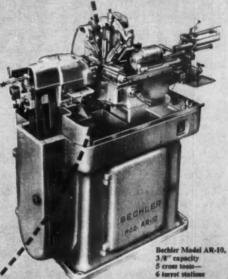
BECHLER SWISS AUTOMATIC

OBTAIN COMPLETELY FINISHED PARTS IN ONE SET-UP

This Bechler AR-10, %" capacity model produced this completely finished leaded bronze nozzle with 11 precise, rapidly performed operations . . . 5 slide tools generated the contour, knurled and centered. 6 turret tools machined the inside—3 straight drilling operations, rough and finish taper drilling, plus threading. All surfaces of this intricate piece are smooth, burr-free and concentric within very close tolerances. Secondary operations with chucking problems, extra handling, concentricity loss and rejects, would have cut profit to the bone.

No matter how intricate the piece, how long the production run, you can produce it better with a Bechler Swiss Automatic.

Bechler Automatic Screw Machines are available with barstock capacities up to 14".



FEATURES

- Turret is hydraulically indexed; adjustable trip-dogs replace indexing cams.
- Turret indexing time is constant (¼ sec. on AR models) no longer depends on camabaft cycle.
- Longitudinal positioning of turret reduces approach travel of spindles.
- Many spindle combinations provide stationary and revolving drill spindles—up to 4 threading spindles.
- Optional pick-up attachment permits back drilling and slotting.
- Optional camshaft accelerator reduces idle time when cycles are relatively long.

Write for further information



Completely tooled dram turret.

BECHLER

Swiss Automatics and Allied Precision Equipment

AMERICAN BECHLER CORPORATION
29 HARBOR STREET, STAMPORD, CONNECTICUT

For more data circle 411 on Postpaid Card



- FIRST FORECASTS FOR 1962 ARE FOR A YEAR OF BIG BOOM. Economists in government and industry are nearly unanimous in projecting rapidly expanding sales and profits. To begin with, they are deeply impressed by the bounce the economy showed during the Spring and Summer—gains that far outstripped expectations. In addition, several factors will be adding new momentum. The experts see powerful new lift coming from three sources: Government spending is rising by billions—for defense, for foreign aid, and for welfare programs. These outlays will have to be financed by a deficit . . . potentially inflationary. Consumer purchasing is due to spurt as jobs and wages rise. Sales don't usually jump till months after an upturn starts. Business investment in inventory and new plant will quickly respond to all the increased government and consumer demand. With these "ingredients" present, booms almost always follow.
- BUSINESS ACTIVITY IS EXPECTED TO RISE 8% to 9%, over-all, next year. (That will be above and beyond the record rate that will be reached at the close of 1961.) This year, the Gross National Product—the best and most comprehensive measure of economic output—will hit a whopping \$518 billion. Next year, the total will make a huge leap—to an estimated \$565 billion. Here's what's ahead for key economic indicators in 1962: Factory output: Gains will average 10%—more for hard goods. Consumer durables: Auto and appliance sales will rise 15%. A near-record 7 million new cars will be sold—maybe more. New home starts: Industry will build 125,000-150,000 more. Incomes: More folks working at higher

wages will lift buying power 6%—solid gains, too, since prices will rise only 1%.

- THE BOOM THAT'S DEVELOPING WILL CUT UNEMPLOY-MENT, but won't solve the problem entirely. Productivity is rising as it always does early in a recovery; a few extra workers can turn out a lot more goods. At the same time, 1 million-plus new workers will be entering the labor force. Thus, even a sharp recovery will only cut the number of jobless from the current 6.8% of the labor force to 6% by year end and to 41/2-5% by the end of 1962. The job gains that will materialize later this year and next will be most numerous in steel, autos, ordnance, machinery, food processing, retailing, construction, and many services. This will still leave a growing group of workers for whom jobs are scarce. Currently, half the idle have been jobless for 15 weeks—another 500,000, for more than a half year.
- CORPORATE PROFITS HAVE ALREADY BEGUN TO RISE from the low level of the first quarter. In the second quarter, earnings nearly matched those of a year ago—a good period generally. As usual, the picture was spotty. On the plus side were the aircraft, finance, food, oil, office equipment, and utilities industries. Declines from 1960 came in auto equipment, chemicals, electrical equipment, steel, paper, textiles and apparel, and the railroads. This year—1961—profits before taxes will total \$45 billion, same as last year but \$2 billion less than in 1959. For next year, corporate earnings could reach a record \$55 billion.
- INDUSTRY WILL SHARPLY EXPAND ITS CAPITAL EXPENDITURES over the next year or so, to make big profits gains possible. Many economists are taking the line that investment in new facilities offers the only real hope of ever widening present thin profit margins. Political pressure makes it harder to raise prices, but labor costs keep moving up. The most promising way out of the squeeze is to lift productivity—which boils down to better equipment. The increase in the minimum wage that took effect on Labor Day is adding more than \$500 million to payrolls directly and many times this indirectly. The indirect impact is expected to show in the pressure for wage increases from higher paid workers determined to protect existing differences in rates.
- GET SET FOR SOME INCREASES IN WHOLESALE PRICES this Fall, despite government resistance. Some gains are inevitable as output gets closer to capacity; many firms will feel more free to pass on increased wage

Report from Washington . . .

costs—those absorbed in the past because of competition plus those on the horizon. In many cases, higher productivity alone cannot pay for higher labor costs. The bellwether for wholesale prices may be steel. Last year's steel contract calls for further increases this Fall that have been estimated at 12¢ or 13¢ an hour. Industry officials do not see how they can absorb all this. This is why talk of hikes in selected items persist, despite the expressions of disapproval that have been voiced by Congressmen and by the White House. Of course, increases in prices that steel-users must pay have to be passed on by the users to consumers.

- WASHINGTON IS CRACKING DOWN ON IDENTICAL BID-DING on U.S. contracts. Scrutiny of reported cases is being tightened—with much fanfare—in hopes offenders will get the point. Even more important, instances of identical quotations on contracts over \$10,000 are being turned over to the Justice Department. Little sympathy is being given to arguments that similar bids—often alike to three decimal places—reflect efforts to meet competition. Officials concede that the legal action they can take isn't very potent. They must show conspiracy to get a conviction, and that's hard to show. So they rely on publicity instead.
- TIGHTER MONEY IS ON THE WAY. It will be a result of action by the Federal Reserve. At first, the steps to be taken will be extremely mild—and their effects hard to see. The Reserve System will simply be making a little less new credit available for the Fall season than it would normally be supplying to the country's commercial banks at this time of the year. Before long, here's what will happen to interest rates: Short-term rates will firm slightly in months ahead. But the chief impact at the banks will show up as a slightly greater degree of choosiness . . . downgrading credit risks. Long-term rates will move up—maybe even a bit faster. The Treasury, local governments, and many corporations will be in the market to raise huge sums by selling securities. To repeat: The tightening will be mild for several months. It will be mid-1962 before credit becomes really stringent.
- THE THREAT OF A NEW DOLLAR CRISIS has Washington officials worried. They realize that the improvement in our international balance-of-payments last Spring was only temporary—the result of a one-shot repayment on a loan to Germany. Washing out this factor, you will find that this country's payments are still exceeding receipts from abroad at a rate of \$2 billion a year.



with a SPEEDICUT "CHIPBREAKER"

The SPEEDICUT "CHIPBREAKER" is not for doughnuts. But when it comes to drilling holes in metal (from \(\frac{1}{4}\)" up to 6" in diameter), at the lowest cost-per-hole, there is no drill made that can do the job like a SPEEDICUT "CHIPBREAKER".

The patented rib* makes the big cost-cutting difference. Permits 50% to 400% higher feed rates . . . deep hole drilling without withdrawais . . . no down time for cleaning out packed spinnings and swarf . . . more holes per regrind.

But don't take our word for it. Let your local authorized SPEEDICUT "CHIPBREAKER" distributor prove it with a "no obligation" demonstration in your plant on your own equipment and type of work.

May we send you his name and a descriptive catalog of the SPEEDICUT "CHIPBREAKER"

For more data circle 412 on Postpeld Card



THE PATENTED RIB that cannot be duplicated

SPECIFY
SPEEDICUT "CHIPBREAKER"
SPEED WITH SAFETY



*U.S. Potent Number 276036

AS

I SEE YOUR SUPERVISORY PROBLEMS

For answers to your perplexing managerial problems address your letters to Mr. Alfred M. Cooper, MODERN MACHINE SHOP, 431 Main St., Cincinnati 2, Ohio.



By ALFRED M. COOPER Consulting Editor, Modern Machine Shop and author of "How to Supervise People."

A letter recently received from a reader posed a problem that for a time appeared insoluble. On the surface it was a simple problem, since it merely asked that I furnish this reader with the names of a number of experts who were authorities on the subject of preventing human waste of time and materials in industry.

Before replying to this query I consulted a number of reference books, principally Who Knows—and What, published by Marquis. And sure enough, under the subject of "waste" I found listed a score of authorities. Some were experts in the treatment of waste in the form of sewage, and there were experts in the treatment of waste products of manufacture, of smoke, gases, and almost any type of waste you could think of, other than that due to human carelessness, ignorance, or deliberate intent.

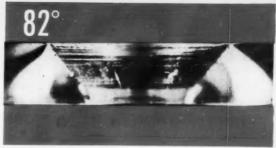
There were listed many authorities on time and motion studies, but here again the subject of deliberate waste of time and waste through the careless handling of finished machine products (as one example) received little attention.

Yet it is exactly this type of easygoing production that is responsible, more than any other factor, for the inability of many of our industries to compete successfully with foreign competition. And of course the prevention of this type of waste is the responsibility, not of those who write the books, but of the immediate supervisor of the man on the job.

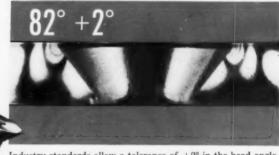
In the case of this inquirer I referred him to those excellent manuals prepared by the American Management Association which deal with the

PQA* proves it...

this Allen Flat Head Cap Screw has complete all-around head contact



PQA makes it certain that an Allen Flat Head Cap Screw has contact throughout the angle of the head with the mating countersunk hole. This assures the strongest possible fastening. In this photo, made with polarized light, you can see the stress points throughout the chamfer.



Industry standards allow a tolerance of $+2^{\circ}$ in the head angle. Allen Flat Heads manufactured to this tolerance have greater bearing at the top of the head—shown by the stress patterns in this polarized light photograph.

*PRODUCT QUALITY ASSURANCE

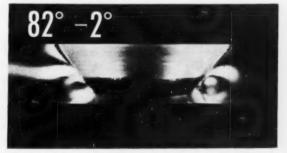
ALLEN

MANUFACTURING COMPANY HARTFORD 1, CONNECTICUT, U.S.A.

Plant at Bloomfield, Connecticut
Warehouses in Chicago, Cleveland and Los Angeles

Genuine ALLEN products are available only through your ALLEN Distributor. He maintains complete stocks close by to help cut your freight costs, inventory, warehousing and handling. He offers fast, single-source service. He knows ALLEN products. And he makes ALLEN Engineering Service available to you any time. Call him!





Industry also allows a tolerance of -2° in the head angle. But Allen does not utilize this negative tolerance. The reason—it is entirely possible to have head seating efficiency reduced because of excessive interference in the head-shank area. The photo shows high bearing stress in this area—with risk of breaking prematurely.

PRODUCT QUALITY ASSURANCE is the symbol of unquestioned quality at ALLEN. It stands for constant quality control every step of the way—your guarantee of quality and reliability.

For more data circle 413 on Postpaid Card

Supervisory Problems . . .

subject of motivating the employee to put out a fair day's work for a fair day's pay. Yet only a day later I was talking to the supervisor of a great aircraft manufacturing plant, whose department concerned itself with the manufacture of new-type guided missiles. And this man, with no prompting, volunteered that there was not a man in his organization whose daily output exceeded the amount of work necessary to barely keep him on the payroll. I am convinced that this man was not a typical supervisor, since when I asked what he was doing to remedy matters, he merely shrugged his shoulders and said, "What can anyone do about it?"

The type of waste of human energy that concerned the inquirer obviously was of little concern to this aircraft manufacturing supervisor. Yet this is exactly the type of waste that can convert any first-class industrial nation into a fourth-rate power.

There are forces operating in this country which will be quite pleased to see this objective attained. These forces sometime operate openly, sometimes under cover. So far as the supervisor is concerned he must consider all such activity as inimical to the future of his plant and his country.

The power of America has always been derived from her ability to outproduce any nation on earth, and to control her domestic markets and also attain her share of the markets of the world. It is here that the industrial worker faces up to his responsibility to remain the greatest producer on earth, or lets his country down flat. No politician, government employee, or professional man can do anything at all about reducing willful waste of time and materials, without the complete cooperation of the industrial worker.

FREE REPRINTS

The following reprints are available free of charge in limited quantities upon letterhead request:

- "Build-Up Tooling Saves Production Time and
- "Cold Extruding Steel Alloys to Precision" "Causes and Cures of Heat Treating
- Distortions in Tools and Dies" "Facts You Should Know About Cutting Fluids"
- "How to Sharpen Face Mills"
- "Hogging-A Job Shop Specialty"
- "Hobbing Automatic Transmission Shafts"
- "Milling Applications Unlimited"
- "Portable Radiant Heater Simplifies Hot Forming Work"
- "Special Tooling Extends Use of Induction
- "Sub-Zeroing Improves Pinion Performance"
- "Welder Manufacturer Reverses Import Trend"
- "The Supervisor and His Boss"

modern machine shop

431 Main St., Cincinnati 2, Ohio

MARMSTRONG SERIES 9 O RATCHET

The ONLY Ratchet with ALL these important features!

- 1) Slenderized head
- 2 Thumb-operated reversing lever specially designed so it won't come off
- 3 Reversing-lever stop (Balland-spring prevents occidental shifting)
- Simple to clean-only tool required is a Phillips screwdriver (wearable parts may be individually replaced)
- (5) Thin handle with knurled grip.



- Hole in handle for
- 1) Fine-toothed gear
- 8 Easy ratcheting action
- 9) 1/4", 1/8", and 1/2" square drives (two handle lengths in 1/2" drive)

All wearable parts are replaceable; individually, inexpensively, easily. With no teeth cut into handle, it need never be replaced. *"ARMSTRONG" on these ratchets guarantees: advanced design, top quality and tool sense.

Extra heavy duty "50" Series ARMSTRONG ratchets (see right) in 1", 34", 1½" and 3½" square drive sizes. Our General Catalog 700, gives complete information on these and approximately 5500 other ARMSTRONG tools. Your local ARMSTRONG Distributors will supply you a Catalog and demonstrate the new ratchets. If you don't know who he is, write us for his name.







ARMSTRONG BROS. TOOL CO.

5228 W. ARMSTRONG AVE. CHICAGO 46, ILLINOIS
For more data circle 414 on Postpaid Card

Enterview with a numerical control job shop general manager—How is an N/C operation organized and run?



intricately shaped gear housings pece no problems when machined on Omnimil and then finish machined to 0.0002 inch on Fosdick Jig Borer.

Successful operation of a job shop equipped with numerically controlled machine tools is being done by Numerical Machining Inc. of Cleveland, Ohio. NuMac, as it is commonly referred to, is managed by its President C. R. Swetel and General Manager Richard Stitt who also had the foresight to see that a job shop does not operate most successfully with numerical control alone. NuMac was formed a little over a year ago as a subsidiary of Industrial Enterprises, a conventional job shop, also of Cleveland. and these firms together are equipped to provide the precision facilities which will satisfy a customer's requirements.

At NuMac the editors of MOD-ERN MACHINE SHOP were shown some very interesting machining jobs and some revealing insights into the operating methods and management philosophies which guide this organization. The equipment consists of two Sundstrand 60 station Omnimils, a Fosdick Model 54-P Jig Borer, and a Giddings and Lewis Di Mil.

Mr. Stitt is very willing to share his experiences with MODERN MACHINE SHOP readers. We began by asking . . .

Richard Stitt (loft) General Manager of Numerical Machining, Inc., and K. M. Getfelman (right) Associate Editor of Madern Machine Shop, examine a spiral form, eluminum alloy impeller during interview.



Q. Where did you see the profit potential in an operation of this type?

A. We determined that the most successful shops today are those that are specializing in a specific type of operation. We decided to be the first in the country specializing in numerical control.

Q. Is numerical control applicable to the low quantity job run?

A. Very definitely. I think the answer to that may be found with the companies who do prototype work and who ordinarily would order castings for four to six pieces. We have been able to convince quite a few of these companies to just order one piece from us and let us know what changes they want of the second piece and we will incorporate the required changes on the program tape which is normally a very minor matter. This saves a lot of money in development processes.

Q. Does this not also save tooling and fixturing costs and lead time?

A. We had one job that required \$4,800 worth of tapes and fixtures. Some other firm running the same job had \$105,000 worth of fixtures. We feel that, on the average, N/C tape and fixture costs will run 20 to 50 per cent of the conventional costs.

Q. Are you capable of doing any type of job work or do you specialize in certain types?

A. No. We say without reservation if you can mathematically describe a part we can machine it. We can accomplish all machining operations including some forms of broaching.

Q. When you say describe a part mathematically—does this not include about any part that you would encounter?

A. Yes. Just about any part to which we can get a cutter.

Q. Would that include grinding? A. No. Actually we do not maintain that we can do every job 100 percent by N/C. This is why we have both companies-NuMac and Industrial Enterprises. When we get a part in here, the first thing we do is decide what operation will be done on N/C machines and what will be done conventionally. N/C is not a cure-all for everything. It is good for some things and not for others. You have to be able to figure out what job or operation to place where. I would like to stress a point here about shops getting into N/C. The approach is not to get rid of all the conventional equipment and go to N/C completely. Conventional

N/C Interview . . .

equipment is still needed. On most of the jobs we do, a portion of the work usually must be done on conventional equipment.

Q. You then must decide the sequence of operations required for any job and that sequence could involve several types of equipment?

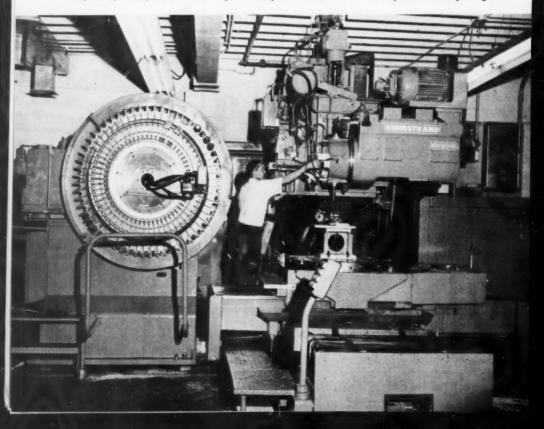
A. This is correct and we are not always right. However, on N/C equipment if we find for some reason that it is advisable to change the sequence of operations, it is much easier to change a program tape than it is to change hard tooling. For instance, we can compen-

sate for part warpage on tape much easier than on hard fixturing.

Q. What type of equipment do you now have?

A. To begin with, we selected the 5-axis Sundstrand Omnimil for the simple reason that it will allow us to do practically any type of machining job. We now have two of these machines on the floor. We also have the Model 54-P Fosdick Jig Borer that will hold two tenths tolerance. The Fosdick has a full three axis control on it. A Giddings & Lewis DiMil is on order and is scheduled for delivery this fall, and we are considering a turret drill for the less complicated type of work.

View of the Sundstrand Numerically Controlled 5-Axis Omnimil that is designed to mill, drill, bore, ream and tap all exposed faces of a workpiece at any angle.



Q. Did you take the control system the manufacturer of the machine tool offered or did you specify a particular make?

A. On the Omnimils and the jig borer, we took the control systems that were offered. The only requirement was that it use as input media the EIA standard eight channel perforated tape. On the DiMil that we have on order a particular control system was specified.

Q. Why did you specify a particular system in this instance?

A. It is the same make that is on the Omnimils and we have had good experience with it. It is easy to program and maintain and the manufacturer has a good field group of maintenance people.

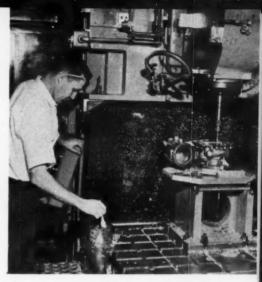
Q. What is the program format of the control systems? Are they word address, fixed sequential, tab sequential or some other kind?

A. The Fosdick system is word address but on the others we have to give full information for each axis in every block of information. If we are not moving on a particular axis in a block of information we put in all zeros.

Q. In an operation of this type, your personnel requirements are obviously different than those of a conventional shop, are they not?

A. Yes. We currently have twelve people, six in the shop and six in the office. The six in the shop are machine operators and tool setup people. In the office, we have our programming and clerical people. The responsibility for the machine output now rests largely in the hands of the programmer.

Q. Do you have trained programmers on your staff?



Close-up view of workpiece on Sundstrand 5-Axis Omnimil. Automatic tool changer for this numerically controlled machine can hold up to 60 tools of $2\sqrt[3]{4}$ inch mean diameter.

A. We have "part programmers" and are training more.

Q. Were your workpiece programmers, or part programmers as they are commonly known, adapted from shop people or did you train persons with other backgrounds?

A. You must have people with shop experience. This is the key to the whole thing. Until we got a computer we had to have people with shop experience and a pretty good math background, but now that we have our computer and have our master programs written, we can get by with less of a math requirement. The part programmers that we will hire in the future will come from the tool design or production engineering classifications.

Q. The master program you mentioned—did you develop it, yourself, or did that come from another source?

A. The one program that we use very extensively was developed by

N/C Interview . . .

Sundstrand Aviation. Other master programs we developed ourselves.

Q. You indicated that you have a computer?

A. It is an IBM Model 1620 card input and card output.

Q. How do you convert the cards to the punch tape?

A. With a Model 063 Card-to-Tape Converter.

Q. What other tabulating equipment do you have?

A. A key punch, verifier, and sorter.

Q. What is the computer rental per month?

A. \$2,080.

Q. Can you justify this rental fee on the basis of your own work?

A. It is justified strictly on our own work.

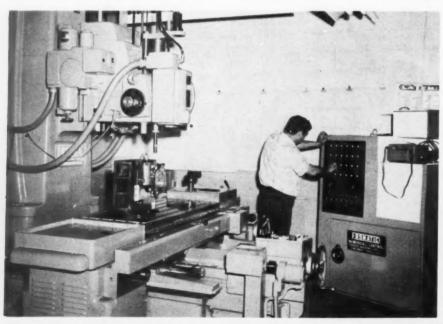
Q. Can you utilize this equipment to meet your requirements with your own staff or do you have to rely on the computer manufacturer's methods people to help you?

A. We know enough about it to do our own work. Once in a while if we get into a particular situation we call IBM and they, without question, will send a programmer to work with us.

Q. Does your rental fee take care of any consultation service and maintenance?

A. Yes, these services are all included in the rental arrangement.

Q. How about the maintenance on the various machine tools and the control systems in your shop?



This illustration provides a general view of Fosdick Model 54-P numerically controlled jig borer which has been set up for finish machining surfaces of aluminum workpiece.

A. You have just mentioned one of the most important areas in which the successful operation of N/C depends—preventive maintenance of the equipment. Every week we perform a hour and a half preventive maintenance check on each piece of equipment.

Q. Does this maintenance program include the control system?

A. This includes running "bit loss" tapes through the reader which check out the control system to make certain that every tape bit is being read correctly. It includes checking the dead band on the servo valves and other minor checks. We even change the light bulbs in the photo electric reader each week. Nobody has told us the bulbs are going to burn out and we know the light bulb may last a month before burning out or vary in intensity but we replace them each week. They cost only 18¢ each.

Q. If a malfunction should occur do you have to call the manufacturer's service representative or do you do your own repair?

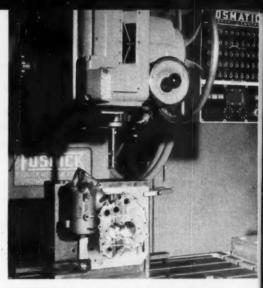
A. We do our own work. We have a man who has been schooled in this equipment and he does both the hydraulic and the electrical work.

Q. Did he have a shop back-ground?

A. He was a shop electrician. This is something that shops should plan — having their own maintenance man.

Q. Are the control systems built so that should a malfunction occur, the source of trouble can be quickly located and remedied by simply replacing a module?

A. This is the ideal approach, but one thing you must remember



Close-up of workpiece being bored on Fosdick numerically controlled jig borer.

is you just do not replace a module without adjusting or setting it to the particular control unit. Perhaps there is a resistor to be added or changed.

Q. Is your maintenance man capable of doing this?

A. He is.

Q. Do you keep spare parts on hand?

A. We keep a complete set of spare modules, servo valves and filters.

Q. Are the control units constructed so that if a malfunction should occur the machine would stop?

A. It stops.

Q. It then has some kind of a checking device?

A. It has a feedback so that if the machine tool does not perform as specified, it stops. The control units are all closed circuit feedback.

Q. Are there also safety devices that would prevent a collision or say the drilling of a hole in the table

N/C Interview . . .

should such a thing be programmed by mistake?

A. That is a two point question and I will have to answer it in two parts. If we, let us say, program to drill a hole through the table of the machine - we will drill a hole through the table of the machine. We have, however, our computer set up so that if we ask it to exceed an axis limit it will stop and we can check it. As for driving a tool into a part, the prevention of this lies with the programmer. One way he can prevent this is to establish a clearance plane above the work. The computer then will prevent a program from being developed which would call for a rapid traverse past this plane. This is not the problem it would seem to be.

This could happen just as much on conventional equipment. I have seen horizontal millers where the cutter has been run right down into the table. This is why we do make a tryout. If a job requires the machining of expensive material, we first test the program by running the job on a piece of Styrofoam plastic. We find that if there are programming errors they are almost invariably in inches and tens of inches not thousandths or tenths.

Q. For the person contemplating bringing N/C into his shop, what is the most important consideration in your opinion?

A. Having in mind the type of work they either are doing or want to do and then getting the machine or machines for this work. There are all kinds of examples of people getting perfectly good equipment



View inside tape preparation room showing an operator at key punch. To the operator's right are a verifier and tape preparation desk. To the rear of operator is a sorter.

120



Model 1620 IBM Computer used in development of continuous path programs for parts.

that does not meet their particular requirements.

Q. What other consideration or considerations are there?

A. Programming must be accounted for. No one should step into continuous path or computer programming without prior experience. The first piece of equipment should be a simple point to point machine for "getting your feet wet" on N/C. If someone is going into continuous path or Kellering or profiling, they should let some experienced continuous path program developer prepare their first tapes. We are doing some of this for companies that are getting continuous path machines.

Q. With the creation of a whole new field of programming and shift in emphasis of the role of the operator, what has been your experience in training N/C operators?

A. We find very little difficulty in training operators for this equip-

ment. They have all run conventional equipment in the past. Sometimes they have pet ideas of feeds and speeds and believe, for example, that aluminum should be run at 250 s.f.p.m. instead of 600 as has been programmed.

Q. Do you find the operators valuable in feeding back to you information that would help in future programming?

A. Definitely. This all funnels back to us through the shop superintendent. As an example, we may program a feed rate of 10 inches per minute on a job, and the operator would see that to obtain the right type of cut the feed rate should be 8 inches per minute. He will check with the superintendent and they will set the feed rate override at 80 percent the first go around and we will then prepare a new program tape with a feed rate of 8 i.p.m.

Q. Is it simple to incorporate a program change into a new tape?

A. Yes, we simply insert a new card in the card program that calls for the new feed rate and then take the cards to the card-to-tape converter and produce a new tape. We use a paper tape that costs \$1.05 per 1,000 feet.

Q. We understand that on your computer developed programs, the output of the computer is a deck of cards which then goes to the card-to-tape converter to make the actual program tape. When a program is developed manually, is the tape produced manually?

A. No. A girl punches a deck of cards and another girl verifies them on the verifier and they then go to the card-to-tape converter.

Q. It appears then that the only way a mistake could creep in would be for both the girl punching and the one verifying to make the same mistake?

A. Yes, but that is virtually impossible. The only other way a mistake could occur would be for the cards to get out of sequence so we have a standing rule that before any tapes are made, the cards are processed through the sorter. It doesn't make any difference if a tape has just been made from a set of cards and an additional tape has to be made even within a half hour, the cards are reprocessed through the sorter to make certain their sequence is correct.

(At this point, the editors were taken on a tour of the shop. Noted among other things was its orderliness and the fact that it was airconditioned. Also noted were some gear housings on which extensive machining operations were being performed.)

Q. You mentioned that air conditioning is a definite asset in your operation?

A. Yes. It cost about \$10,000 to air condition the shop and offices. Any equipment works better in a controlled environment and since we work in tolerances that are tight, there is no sense in buying a machine tool that will machine to a tenth unless you are going to hold the part dimensions.

Q. What temperature do you maintain the shop?

A. 73 degrees plus or minus 3 degrees.

Q. Do you have any plans for retrofitting any machine tools with numerical control?

A. I do not believe in retrofitting for machines in our shop. There may be some perfectly good and logical reasons for doing it in some instances but, in general, a control unit is a substantial investment and it will not improve the production tolerances of any machine tool. The make-up of the machine, the ways, and so forth are different on N/C equipment, and I think, in general, N/C should only be put on those machines that have been designed for it.

Q. There were two gear housings that we saw in the shop. You mentioned that they were done on the Omnimil with the precision finish holes being done on the jig borer. What do you feel has been saved in both production time, lead time and cost by doing these jobs on N/C equipment rather than on conventional machines?

A. I would say in the machining process alone, the savings are between 30 and 40 percent. The total tooling savings are probably 90 percent, and we cut three months off the lead time. These are both small lot runs.

Q. We have noticed the small object on your desk which appears to be an impeller of some type?

A. Yes, this is an impeller that is made from a solid billet into the configuration seen here. We take one roughing pass and two finish passes. Fixturing consists of only a small plug that this is mounted on and it is bolted in the center to hold it down. The programming time on this was 4 hours and machining time is 33 minutes per piece.

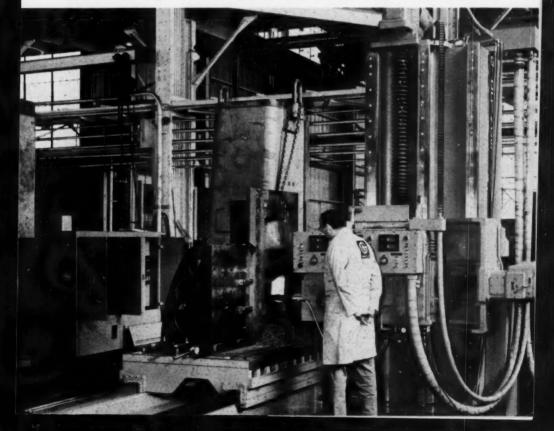
Q. If you were doing this by conventional methods, what do you think would be involved?

A. On a conventional method, the only way to run this, of course, would be a dividing head or similar arrangement cocked up at an angle on a vertical mill and you would have to tie in the rotation of the dividing head with the travel of the table. It would be a complex set up and would probably require 30 hours to make the part.

Q. Would succeeding parts also require 30 hours?

A. No, in quantity runs you could probably get your parts down to around 6 or 7 hours per piece.

This illustration of a Giddings & Lewis DiMil 3-axis profiler represents the latest type of numerically controlled equipment acquired by Numerical Machining, Inc.



Solid Propellant Cases Produced by Ardeform Process

A cryogenic metalworking method provides for significant improvement in strength and ductility.

A variety of workpieces including solid propellant rocket engine cases and helium storage spheres for satellites may now be simultane-

X SAN COULT 103

Close-up shows two Ardeform vessels fabricated of 301 stainless steel. Vessel at left is unstretched preform with a nominal tensile strength of 102,000 p.s.l. One on right has been stretched approximately 13 percent by the Ardeform process and strengthened to a nominal tensile strength of 260,000 p.s.i.

ously stretched and strengthened by means of a process known as Ardeform which has been introduced by Arde-Portland, Inc. of Paramus, New Jersey. Developed primarily for the fabrication of large, high strength, solid propellant rocket cases, the Ardeform process is also expected to find application outside this field in the fabrication of thin-walled pressure vessels, mobile cryogenic storage containers, and high strength tubing.

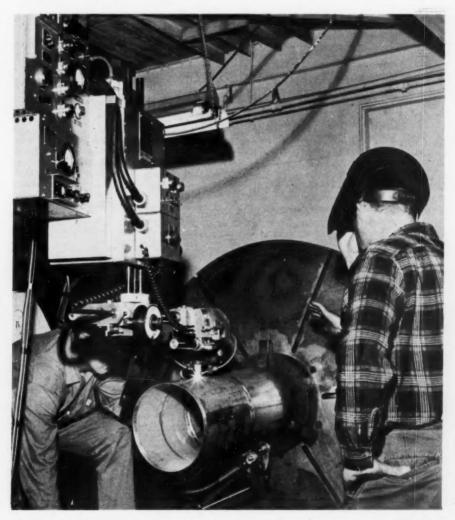
The company has fabricated spheres up to 16 inches in diameter and cylinders up to 4 feet in length by $12\frac{1}{2}$ inches in diameter. A cylinder 30 inches in diameter is now in the works and larger ones are

contemplated.

In the Ardeform units produced to date, Arde-Portland has demonstrated nominal tensile strength of 285,000 p.s.i., equivalent to strength-to-weight ratios of over 1 million inches. With suitable design and material selection, it is said that nominal tensile strengths should reach 400,000 p.s.i. and strength-to-weight ratios, 1.4 million inches.

Ardeform is essentially a cryogenic stretch forming process. The principle behind it, which was discovered some time ago, is that cold working at cryogenic temperatures markedly improves the room temperature strength of austentic stainless steels.

It proved impossible, however, to realize the full strength of these



Welders at Arde-Portland, Inc.'s plant in S. Portland, Maine, check the operation of an automatic welding unit purchased for use in the company's new Ardeform metalwork-

ing process. Automatic, seam-tracking head produces high quality welds capable of successfully undergoing a sizeable amount of stretching at cryogenic temperatures.

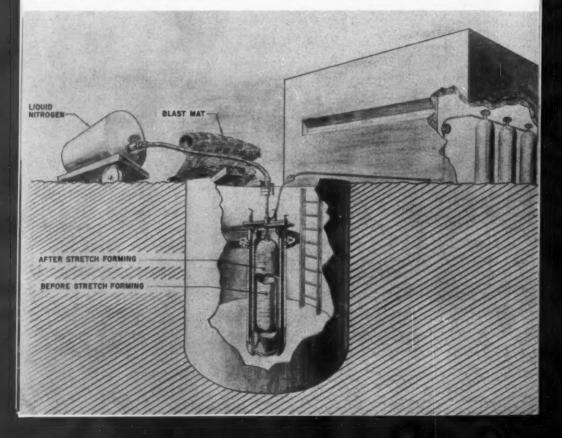
"Inexpensive roll and weld techniques are used."

cold-worked steels in fabricated units such as cylinders and spheres which required welding because the heat produced by the welding reduced the yield strength of the cold-worked material in the area of the weld by more than 80 percent. But now, Arde-Portland has solved this problem. In Ardeform, the unit is first formed and then worked so that the welds as well as the base material are properly strengthened.

Drawing shows Ardeform pilot facility now in operation at Arde-Portland, Inc.'s plant in S. Portland, Maine. Large, outer pit is 12 feet deep and 10 feet in diameter. In the center of the pit is the insulated forming tank which contains the forming die and the preform. In an actual run, the forming tank and the

The first step in Ardeforming is the fabrication of an undersize vessel called the preform. For cylindrical vessels, annealed sheet stock is used as received to make the cylinder sections. Inexpensive roll and weld techniques are used; but good weld quality standards must be maintained to permit the sizeable amount of stretching (up to 13 percent in diameter) that takes place. Arde-Portland now employs

preform are filled with liquid nitrogen from the small trailer to the left. After the preform reaches minus 320 deg. F., the liquid nitrogen line is removed from it and the high pressure nitrogen gas line from the blockhouse is attached to the preform, which is then stretched approximately 13 percent.



an automatic, seam tracking, welding unit.

Stainless steel is also used for the heads or end closures which are hydroformed and then, to prevent cracking due to residual forming stress, quickly annealed. After the bosses are welded on, the heads are welded to the cylinders.

The preform is then placed inside a stainless steel forming die in the steel forming tank. The die is simply a rolled and welded cylinder of a specified diameter. The preform is clamped to the forming tank to prevent it from floating and the forming tank is filled with liquid nitrogen to a level well above that of the preform. The preform is then filled with liquid nitrogen and sealed off except for a pressurizing line which leads to a supply of compressed nitrogen gas.

The outdoor pit in which the stretching operation takes place is then covered with a blast mat, and the workers retire to the blockhouse from which the rest of the operation is controlled. After the preform reaches liquid nitrogen temperature. the pressurizing line is opened and the preform is expanded by gaseous nitrogen. During stretching, workers watch for a sharp rise in the pressurization rate which indicates that the preform has reached the die. Final pressure may exceed first contact pressure by as much as 12 percent.

After the preform is stretched, a vent is opened to release the pressure. The vessel is then removed from the forming tank, emptied of liquid nitrogen, and taken back into the plant for final machining.

Most of the Ardeform operations



Worker at Arde-Portland, Inc. removes pressure vessel from forming tank after it has been cryogenically stretched. Asbestos gloves are needed because vessel is still at liquid nitrogen temperature (minus 320 deg. F.).

to date have been carried out with AISI 301 stainless steel. The company has done some work with AISI 302 and 304 steels. The process should also prove effective to a greater or lesser degree with all other austenitic stainless steels. Arde-Portland is also experimenting with other metals such as aluminum and titanium.

Of the stainless steels used, 301 appears best suited to Ardeforming because it achieves its maximum strength with a minimum of working. The steels with higher nickel content such as 302 and 304 require more reduction to produce a given strength; but 302 may be preferred to 301 in certain types of applications where greater local ductility is desired or required in the preform.









THE DETROIT METAL SHOW















Cobo Hall, where the 1961 Detroit ASM Metal Show will be held from Oct. 23 through 27.

- · METAL TREATING INSTITUTE
- MERICAN GAS ASSOCIATION
- · AMERICAN WELDING SOCIETY
- SPECIAL LIBRARIES ASSOCIATION
- METALLURGICAL SOCIETY OF A.I.M.E.
- METAL POWDER INDUSTRIES FEDERATION
- SOCIETY FOR HONDESTRUCTIVE TESTING
- ULTRASONIC MANUFACTURERS ASSOCIATION
- INDUSTRIAL HEATING EQUIPMENT ASSOCIATION

October, 1961

Latest advances in engineering materials and materials processing will be reported in 68 half-day sessions of the 1961 Detroit Metal Show, October 23-27 in the Motor City's beautiful new Cobo Hall. Outstanding speakers have been programmed from many parts of the United States and Canada, representing leading industries and research laboratories. Everything from metal producing to atomic energy, including processing, testing, plastics, automobiles, aerospace vehicles, instruments and many others, will be covered in more than 200 papers.

The Metal Congress portion of the 1961 Detroit Metal Show will be a "team" achievement, with ten American technical societies and trade associations participating in the Congress Program. This event marks the largest number of societies ever to participate in an educational project of this type, presenting the largest number of technical papers in the largest number of technical sessions.

For the first time in many years, all Metal Show exhibits and most technical sessions will take place under one roof. This is made possible by the excellent meeting room facilities at Cobo Hall, adjacent to the exhibit halls that will be filled by the 275 Metal Show displays. Nine of the societies will be holding sessions there.

The Congress will begin Saturday, October 21, with the annual ASM Seminar. "Ultra-High Purity Metals" is the timely topic to be discussed at the two-day event. Morning and afternoon sessions are scheduled for both Saturday and Sunday.

ASM's Engineering Conference sessions will get underway Monday morning, October 23, with a meeting on "Corrosion in Automotive Applications." The Conference, which treats timely engineering topics for immediate application in metalworking plants, will continue through Thursday. Sessions include such important aspects of materials and processing as "Cold Forming of Metals," "New Metal Removal Techniques," "Nonmetallic Materials," and "Light Metals."

Transactions sessions of the ASM will be presented concurrently with

the Engineering Conference. These papers cover more highly technical aspects of metal science, and include such topics as "Mechanical Properties of Steels," "Carbides in Steels," "Iron-Chromium Alloys," "Nuclear Metals," "Plastic Deformation," "Physical Metallurgy," "Space Age Metals," and "Corrosion."

Finale of the ASM 36-session program will be an ASM special session Friday morning, Oct. 27, on "Economics of Literature Searching in Research and Engineering." During the Congress, ASM will have presented 28 technical sessions and eight more as joint sessions with other societies. In addition, Metalurgical Society of AIME will hold 19 sessions, meeting Monday through Thursday, while Society for Nondestructive Testing is holding 13 sessions Monday through Friday.

Participating Groups

Participating with ASM in joint sessions will be American Welding Society, (2 sessions), American Gas Association, Industrial Heating Equipment Association, Metal Powder Industries Federation, Metal Treating Institute, Special Libraries Association and Ultrasonic Manufacturers Association.

Addition of AWS and AGA to this year's program, according to DuMond, accounts for the record number of participating societies. The Welding Society and ASM will hold a *joint symposium on welding* Thursday, October 26, with morning and afternoon sessions at Cobo Hall. Subjects will be "New Welding Processes" and "Gas Shielded Welding Processes." Title of the

ASM-AGA session is "New Equipment and Techniques in Melting and Heat Treating."

"Industrial Oven Applications in Metal Processing" is the subject of the joint symposium of the ASM and Industrial Heating Equipment Assn., a Tuesday morning feature of the Metal Congress. Wednesday, ASM will hold a joint session with Metal Powder Industries Federation, title to be announced.

A joint heat treating panel session is scheduled for Thursday morning by ASM and Metal Treating Institute which will answer the



question "Can Your Costs Be Reduced By Brazing Techniques?" Thursday afternoon, ASM will join with Ultrasonic Manufacturers Association in a session highlighting "Recent Developments in Ultrasonic Cleaning, Machining, Joining and Inspection."

Society for Nondestructive Testing, also meeting at Cobo Hall, will present 13 sessions, including an educational survey, "Military Ordnance and Nondestructive Testing," "New Application of Radiographic Techniques," "Electrical and Magnetic Techniques." "Nondestructive Testing in the Utilities Industry," "Transportation and Nondestructive Testing," "Ultrasonics Research and Standards," "Licensing and Proper Use of Isotopes in Industry" (Panel discussion), and "General Application of Non-Destructive Testing."

19 technical sessions of the Metallurgical Society of AIME will take place in the Pic-Fort Shelby Hotel, near Cobo Hall. AIME will concentrate 14 of these sessions on Monday and Tuesday, following with five more on Wednesday and Thursday. Such subjects are scheduled as "Refractory Metals," "Theory of Work Hardening," "Effect of Surface and Environment on Strength," "High Purity Iron and its Dilute Solid Solutions." "Titanium in 1975," "Continuous Casting," "Nuclear Fuel Reprocessing," "Vacuum Techniques," and "Powder Metallurgy."

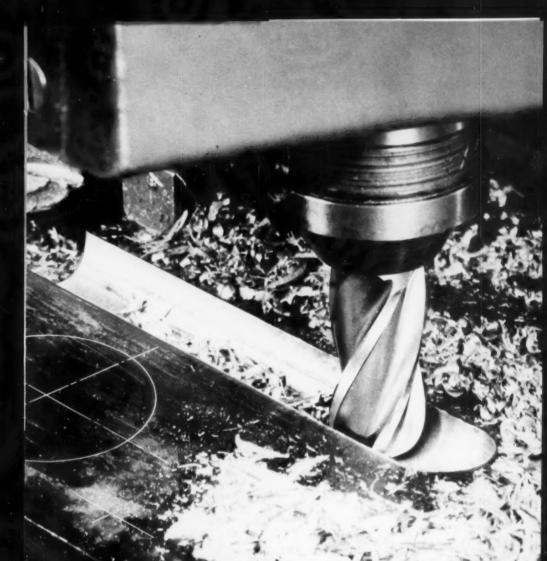
With an average of more than six technical sessions taking place at one time throughout the week in Cobo Hall, visitors will have much from which to choose.

Convention Committee

A king-sized convention committee of Detroit members of the American Society for Metals is providing enthusiastic cooperation with the society's national headquarters staff to assure success of the 1961 Detroit Metal Show. Under the chairmanship of Donald J. Henry, the committee has been organized into 11 sub-committees planning and executive operations covering registration, attendance, housing, speakers, plant tours, coordination, banquet, hospitality, special events and ladies' entertainment.

Mr. Henry is assistant head of the metallurgical engineering department of General Motors' research laboratories. With him on the Detroit committee are Robert Sergeson, Jones & Laughlin Steel Corp., vice chairman; W. C. Morgan, Penn Petroleum Corp., registration and reception; G. Frederick Bush, Ford Motor Co., cooperating societies: W. P. Lewis, Hamler Industries, attendance; and Howard N. Bosworth, Bosworth Steel Treating Corp., banquet.

Other committee members are Robert B. Boswell, Chrysler Corp., reception center and hospitality; T. C. King, Republic Steel Corp., plant visitation; A. DiGiulio, DiGiulio Foundry Co., speakers bureau; George Bidigare, Commercial Steel Treating Corp., science and vocational teachers; Phyllis LaBelle, ladies' entertainment; Robert H. Shoemaker, Kolene Corp., arrangements and Richard A. Flinn, University of Michigan, special events.



The story behind the chips



Savings In Time—Lower Tool Costs— Finer Finishes — More Accurate Cuts

Many types and sizes of *standard* Putnam End Mills are considered as "specials" by other manufacturers. Thus, Putnam customers get off-the-shelf deliveries that get their end mills on the job faster and at lower cost than "specials."

On the job, Putnam End Mills again save time and money. Designed for fast, free-cutting action, these end mills have extra long life. They will stand up when operated at high speeds and heavy feeds—on the toughest metals they really "hog-in" to quickly remove stock.

For applications requiring accurate cuts, Putnam's attention to manufacturing details and rigid quality control assures complete uniformity in each end mill. Also, users often find the exceptionally fine finishes obtainable with Putnam End Mills eliminate the need for grinding or hand finishing.

A pile of chips—the milling job is completed. But, for users of Putnam End Mills, there is always a story of unusual savings and benefits behind that pile of chips.



PUTNAM

TOOL COMPANY

2981 CHARLEVOIX AVE. . DETROIT 7, MICHIGAN

A O BUT

MILLING ALUMINUM – Putnam has a complete line of *standard* end mills that are specifically designed for efficient milling of aluminum and aluminum alloys.



Over 1800 Standard Types & Sizes of Putnam End Mills

Now you can order standard end mills ranging in diameter from 1/32" to 6" and get off-the-shelf delivery. In the Putnam line of over 1800 standard types and sizes are many end mills that are considered as "specials" by other manufacturers.

For example, in the MITEE-MITE series of standard end mills, diameters as small as 1/32" are available. Thus, your milling, profiling, routing or engraving jobs in small or hard-to-get-at areas can now be done without special tooling.

Regardless of your requirements, there probably is a Putnam standard end mill that will exactly meet your needs. You can get all the superior Putnam cutting qualities for milling: intricate shapes, deep cuts, tough materials, aluminum, etc. — without purchasing costly specials.

Contact your local Putnam Distributor, he will recommend the best end mill for each specific job and give you quick delivery from his stock.

ON THE BIG JOBS—Putnam Postiv-Lok will cut your costs over 25% on end mills 1½" in diameter and larger. Quick delivery from stock on diameters to 3".



Putnam end mills are made by specialists who work in a modern plant having the finest equipment available. Every end mill is machined from high speed steels of rigid Putnam analysis, heat-treated in our own plant and produced under close quality control. Because *end mills are our business*, we carefully guard their reputation for quality and performance with individual inspection on a score of important details.



DISTRIBUTORS
IN CITIES
COAST TO COAST



UNIVERSAL ENGINEERING COMPANY · FRANKENMUTH 9, MICHIGAN

For more data circle 416 on Postpaid Card

219

October, 1961

MODERN MACHINE SHOP

133

Machining small to Precision Tolerances

Quality control enables mass production of spur gears with less than 0.00025-inch composite error.

By WINFRED M. BERG
President, PIC Design Corporation,
Subsidiary of Benrus Watch Co., Inc.

The need for extreme accuracy in electro-mechanical systems which control and operate many of today's advanced computers, servo systems, space vehicles, airborne instruments, military equipment and industrial processes, has created an urgent demand for precise mechanical components. Without these components, the precision so necessary for successful operation of these systems is unobtainable.

Only a few short years ago, such basic components as spur gears could not be obtained with less than 0.006 inch composite error except by cutting many gears and selecting those within tolerances (*). Today, precision-instrument gears are mass-produced with a maximum total composite error of 0.00025 inch. This is accomplished largely by extra steps to insure precision and by a quality control system pertaining to all phases of gear manufacture.

Gear Blank Preparation

Precision gears are made in three basic types—hubless, split hub and pinned hub (**). Blanks for hubless gears, of course, have no provisions for hubs whereas those for split and pinned-hub gears are turned down

(**)Hubless gears are later assembled with independent hubs or with other gears in the field. They are made for applications where total composite error up to 0.00100 inch is allowable.



Fig. 1—Pratt & Whitney pneumatic gage inspects bores for diameter, taper, bellmouth.

^(*)Composite error is the total of the maximum plus and minus deviations from the pitch radius.

from the outside diameter to hub diameter. Split hubs are slotted 90 degrees apart so they subsequently may be tightened against the shaft by standard clamping components. Pin-type hubs have both set screws and shallow guide holes for drilling hub-and-shaft for straight or tapered pins when the gear has been correctly assembled with the shaft. Most precision gears are of the pin-hub type.

Most precision-instrument gears are made from 303 stainless steel or 24ST aluminum. Since many precision-instrument components are used by the military, these metals are purchased to meet military specifications. All metals must be certified by the supplier to be new and virgin and copies of these certificates are furnished to the purchaser of the end product upon request.

Batches of gears are produced when the inventory control system indicates the supply of a given gear has reached the low-supply stage. When production receives an order to produce a batch of gears, it requisitions the required number of gear blanks from the stock room. The number of gears produced at any given time depends on the turnover of the particular item and is indicated on the work order. Gear blanks to one set of specifications are used as the basis for finished gears made to several sets of specifications. Just as finished gears are produced from gear blanks when the inventory system indicates, gear blanks are in turn produced when the supply of a given size runs low. The fact that gear blanks and finished gears can be produced in lots rather than one. two or three at a time, and the fact

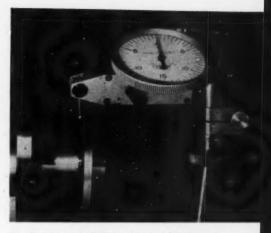


Fig. 2—Face whobble in the gear blank must not exceed 0.0002 inch per inch of diameter.

that finished gears to meet several specifications can be made from one size gear blank, make it possible for the precision component specialist to produce these items at lower cost and more accurately than internal machine shops.

In producing gear blanks, a Brown and Sharpe automatic screw

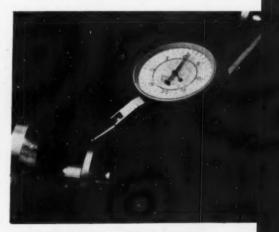


Fig. 3—The outside diameter of the gear blank must be concentric within 0.0001 inch.

"... bench lathe chamfers and breaks all outside corners."



Fig. 4—Precision 1 gears are hobbed on a fixed arbor, as shown in this illustration.

machine is used for blanks up to 1½ inches in diameter and a Warner & Swasey turret lathe for blanks 1½ inches and larger in diameter. In the primary blanking operation, a skim cut is taken off the outside diameter of the bar stock for a length slightly exceeding the overall thickness of gear and hub, if any. The end of the bar is then turned down to hub diameter, if any, a center hole is drilled, and the blank cut off. In drilling the center-hole, a 0.010-inch thickness is left for subsequent finish boring.

For other than precision gear making, all blanking operations would normally be completed in the primary operation outlined above. However, for precision components the following secondary operations are performed:

The partially completed blanks go to a Hardinge lathe which faces off the outside gear face and hub to overall dimensions. One face of hubless gears is finished at this time. Pin-hub gears then go to a drill press which drills and taps the hub for a set screw, deburrs the tapped hole, and drills the shallow pilot hole. Split-hub gears go to a milling machine which cuts the slots that enable the gear to be clamped tight to the shaft. All gears then go to a bench lathe which chamfers and breaks all outside corners.

Pin-hub drilling and deburring, split-hub slotting, and chamfering are all done before boring to mini-

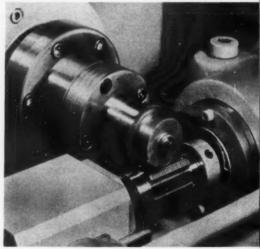


Fig. 5—Precision 2, 3 and Ultra Precision gears are hobbed on a "floating" type arbor.

136

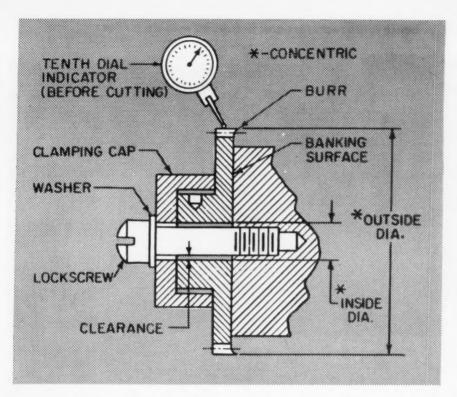


Fig. 6—Line drawing giving details of a "floating" type arbor, as illustrated in Fig. 5.

mize the chance of burrs on the finished bore. The blanks next go to a Hardinge precision lathe for the critical boring operation. They are positioned in a special Swiss precision chuck which holds the finished face perfectly perpendicular to the spindle of the machine with the spindle axis at the center of the hole. The hole is then bored to finished dimension.

Bores of all gears are well within plus 0.0005 inch and minus 0.0000 inch of nominal diameters (Precision 1 bore tolerances). Approximately 85 to 90 percent are within plus 0.0003 inch and minus 0.0000

inch (Precision 2 tolerances), and 30 to 40 percent are within plus 0.0002 inch and 0.0000 inch (Precision 3 tolerances). Approximately 25 percent are within 0.00015 and 0.0000 inch (Ultra Precision tolerances).

Bores are 100 percent inspected with go-no-go gages and also with a Pratt & Whitney pneumatic gage (Fig. 1), which not only checks bore diameter but also indicates whether it is perfectly cylindrical or is tapered or bell mouthed.

At this point, the gear blank goes to the storage bank until called for for finishing. If it is to be made into

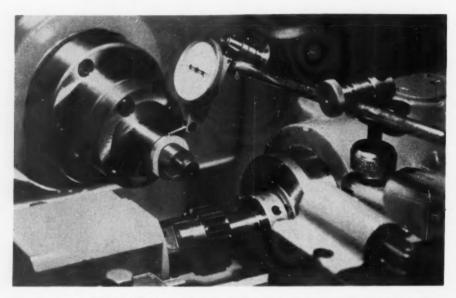


Fig. 7—Before hobbing, blank is adjusted so that it is concentric with center of arbor.

a Precision 1 gear, no further bore inspection is made but if it is to be made into a Precision 2, 3 or Ultra Precision gear, the bore is again checked and the blank selected only if it meets Precision 2, 3 or Ultra Precision bore tolerances.

If selected, the blank is then mounted on a lathe arbor which has been turned for a snug fit with the gear bore. The unfinished face is then finished to provide the specified thickness between faces, and the outside diameter is turned to the size required for the desired number of teeth. The blank is inspected for face wobble, as shown in Fig. 2. Maximum allowable wobble is 0 0002 inch per inch of diameter. The outside diameter is also checked and it must be concentric within

0.0001 inch (Fig. 3). After the precisely turned blank has been checked once, it is rotated 180 degrees on the arbor and checked again.

Anodizing

Aluminum gears are now anodized to protect them from corrosion. This is done by an outside vendor. It must be done before hobbing because commercial plating establishments cannot control their operations to the degree that is necessary in order to maintain precise dimensions machined into a finished gear.

Hobbing

The next step is hobbing and this involves three important elements:

the hobbing machine, hobs and tooling.

Tooling

Taking the last item first, tooling for holding the blanks in the hobbing machine is of two types, depending on the precision required. The first involves a fixed arbor (Fig. 4) used for Precision 1 gears. The blank is fitted onto a shaft which has been turned for a snug fit. The shaft is mounted between fixed head and tail centers and the blank hobbed.

For Precision 2, 3 and Ultra Precision gears, to avoid inherent inaccuracies due to the impossibility of exact line-up of opposing head and tail center, a "floating arbor" technique is used. Here the blank is secured to a banking surface by

Fig. 8-Blank in the process of being hobbed.

a clamping cap and lock screw (Figs. 5 and 6). Before hobbing, the blank is adjusted so it is concentric with the center of the arbor, as indicated by a rigidly mounted dial indicator (Fig. 7). The deviation from zero must not be greater than 0.0001 inch. Once this concentricity is indicated, the blank is ready for hobbing (Fig. 8).

The most critical factor in hobbing precision gears is the indexing of the gear blank from one cutting position to the next. To achieve the desired precision indexing, the machine manufacturer, the Barber-Colman Co., hand pairs the index worm and mating worm gear by selective inspection to provide indexing that is guaranteed accurate within 20 seconds of arc. PIC Design has 10 of these hobbing machines. Two of these machines are said to have better indexing accuracy than the other eight machines and are used for all Ultra-Precision hobbing.

Even with this built-in precision, when the last tooth is cut, it will be thicker or thinner than the others due to cumulative indexing error, small as it is, cutter errors, and blank eccentricity. In the event that the final tooth is on the thin side. there is nothing that can be done to make it match the others. However, if it is on the thick side, it, as well as any other oversized teeth, are cut down when the gear is indexed to a new starting point and the machine run through a complete new cycle. The machine will "cut air" between exact or thin teeth and will trim oversize teeth. This operation is costly and time consuming for only a few teeth will be cut on the second cycle, yet it is necessary

"The removal of burrs is done by hand polishing."

for the production of Precision 2, 3 and Ultra Precision gears.

After gear cutting, the next essential step is the removal of burrs at the edge where the hob leaves the gear. This is done by hand polishing. Although this method presents the hazard of pushing burrs back into the teeth it has been found to be the best method available. While other more modern methods were found effective in removing burrs, they were often found to present new problems such as rounding the edges of teeth, changing teeth

edges of teeth, changing teeth

Fig. 9—Finished gear inspection is performed on a Schoppe & Fraeser tester, as shown.

shapes, bellmouthing bores and affecting the set screw fit.

Hob Maintenance

Hob maintenance is an all important factor in precision gear cutting, and to maintain the cutting accuracy required, hobs cannot be sent out for sharpening. They must be sharpened under the close control that only inside shop work and supervision can provide.

Finished Gear Inspection and Maintenance

After the cutting operation, all Precision 2, 3 and Ultra Precision gears are inspected on a Schoppe & Fraeser tester (Fig. 9). They are driven through one complete revolution by a master gear of known accuracy. The spindle on which the test gear is mounted moves toward or away from the master gear as individual teeth mesh and unmesh. and as the pitch radius varies. The resulting motion is recorded on a tape, thus producing a profile of the gear which indicates variations between teeth, deviations of pitch radius from normal, and total composite pitch-radius error (Fig. 10). For Precision 2 gears, maximum tooth-to-tooth error is 0.0003 inch and maximum total composite error is 0.00050 inch. For Precision 3 gears, maximum tooth to tooth error is 0.00015 inch and maximum total composite error is 0.00020 inch. "True-Blue" tapes are supplied with all Precision 2, 3 and Ultra Precision gears, and are available at slight additional charge with Precision 1 gears. Maximum tooth-

140

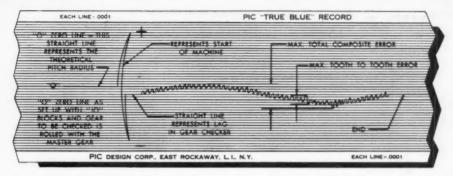


Fig. 10—"True-Blue" tape, such as illustrated herewith, gives developed profile of gear and indicates maximum tooth-to-tooth error and maximum total-composite error.

to-tooth error on Precision 1 gears is 0.0004 inch and total composite error is 0.00100 inch.

Passivation

Following inspection, stainless steel gears are passivated to military specifications.

Packaging

Next, and finally, comes packaging, an extremely important function, since one careless bump or single nick in transit can make useless all the care machined into the gear. To assure protection until placed in service, gears are immersed in a potting compound which covers them with a protective coating.

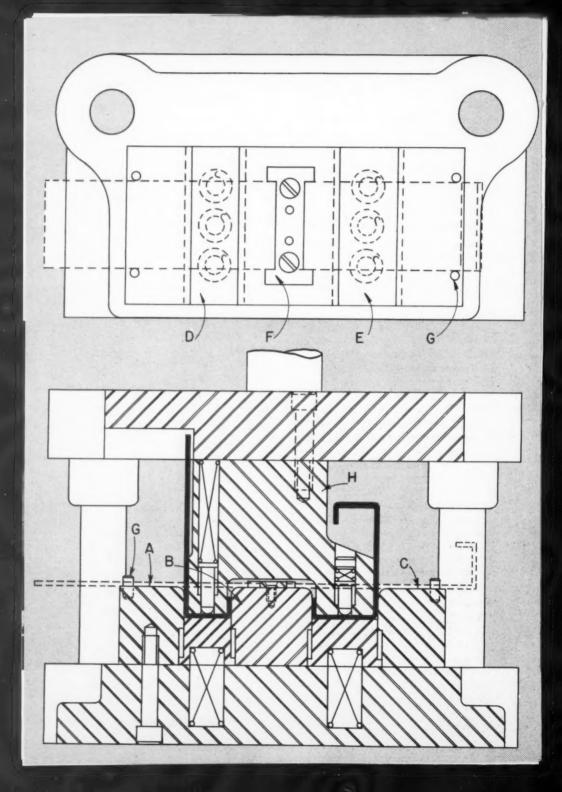
Customer Receiving and Inspection

One more hurdle is yet to be passed before the precision gear reaches the point of application, and that is the customer's incoming receiving and inspection department. Too many times poor handling caused by a lack of understanding of the precision built into these

components results in damage which renders them useless. Education of receiving and inspection personnel as to the nature and dollar value of these precision components is the only way to reduce the loss caused by carelessness and irresponsibility in this one particular area.



October, 1961



Two-Station Die Forms Special Channels

Complete piece is produced with every press stroke.

BY ROGER ISETTS

Shown on the page at the left is a die that was made to produce an overbent channel in one press stroke. The part was made of 18 gauge cold rolled steel and had two different size legs. Making an expensive and complicated cam actuated die was ruled out for numerous reasons.

The illustrated design is a relatively simple, troublefree die that produced acceptable parts, vet made a completed piece with every press stroke. Basically the die consists of three separate form blocks, A. B. and C. which are screwed and dowelled to the bottom die shoe. Two spring-loaded pressure pads, D and E, are located between the form blocks. These pads are made with shoulders that restrict their upward travel. A flat locating gage, F, is secured to the top of the middle form block for nesting the blank at each station. Four small dowels, G, are used as outboard gages. The forming punch, H, is one piece of tool steel bolted directly to the top shoe. It contains several springloaded pins which serve to strip the part off the punch on the ram upstroke.

At the first station the flat blank is laid down and the smaller leg formed. A slot is milled out of the top shoe for clearance as the part is bent up. This prevents the punch from becoming excessively long and also keeps the shut height of the die within the limits of the press. The partially completed part is then moved to the right-hand station and another flat blank is

placed in the first position.

The angle on the punch at the final station helps to shed the part as the die opens, eliminating the necessity of operator picking the completed piece off by hand.



Numerically controlled machine tools are rapidly gaining acceptance as vital cost and time-saving implements of the metalworking arts. Because they introduce some new concepts of shop operation, MODERN MACHINE SHOP is presenting a series of articles dealing with the basic funda-

mentals of numerical control. Last month the first article in this series covered the areas of definition, method of operation, equipment, and the particular shop situations offering profitable application of this type of equipment. Point-to-Point programming will be next month's subject.

A wide variety of metal working operations are now being performed by means of numerically controlled metalworking equipment. Virtually all cutting and punching type operations fall into two classifications that have been designated

with the descriptive terms Point to Point, sometimes known as Discrete, and Continuous Path.

Point to Point is an operation whereby the working spindle or punch as the case may be goes to a specific location on the workpiece and performs the necessary operation or operations. These would include drilling, tapping, boring and punching. The tool then moves to another location on the workpiece and performs the programmed

operations. While moving from one point to the next the tool is not in contact with the workpiece. This process continues until all the necessary steps are finished and a new piece is loaded into the machine and

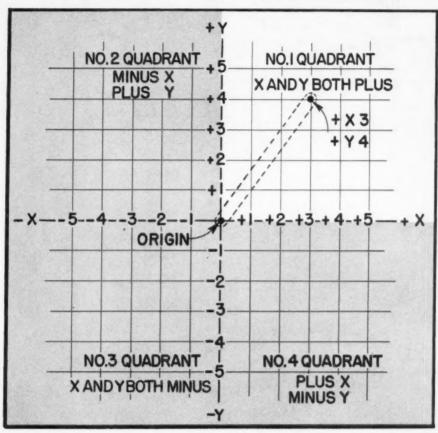


Fig. 1—Cartesian or Rectangular Coordinates. Nearly all numerically controlled machine tools manufactured today are designed so that all locations can be designated in Quadrant 1 with positive numbers. The origin point may be the corner of the work table or may, in machines with a zero shift, be relocated at a point on the workpiece itself. If a hole is to be drilled at the X3 Y4 location the center point of the drill is directed

to the programmed point. If a slot represented by the broken line is to be milled from the origin point to X3 Y4, the center point of the cutting tool is sent from the first to the second position. Slot width is determined by the cutting tool diameter. To get this straight line configuration, the table drive screws or spindle moving mechanisms would be controlled so that 3 units of X motion occur simultaneously with 4 units of Y movement.

the whole program is repeated. An alternative method commonly used is the movement of the loaded work table under a fixed position spindle.

Continuous path operations are just what the term implies. A milling cutter, grinding wheel, flame cutter or welding head, as examples. follow a predetermined path and work as they travel. The concept is somewhat different since the path of the tool is the important factor whereas in point to point the path the tool takes to get to a specific location carries no particular significance. Whatever the classification, machining locations on the workpiece are based on Cartesian or Rectangular Coordinates (Fig. 1) which measure distances from a

specific reference point or origin.

A simple illustration of an origin and measurements from it can be seen on a standard sheet of graph paper with a heavy line drawn from the top to bottom along the middle line and known as the Y axis, and another heavy line drawn from side to side along the middle line which is the X axis. The point at which the X and Y axes intersect is the zero point or origin (Fig. 1). The sheet of graph paper is now divided into four sections or quadrants. X values to the right of the origin are positive and those to the left are negative. The Y values above the origin are positive and those below are negative. Notice only the upper right hand quadrant has positive

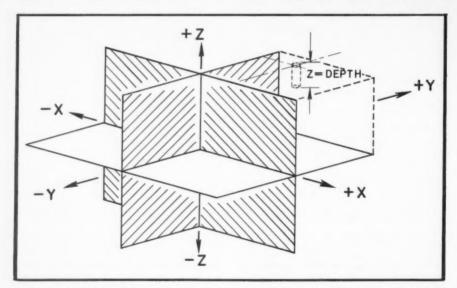


Fig. 2—Three dimensional coordinates view showing depth as a measurement along the Z axis. On most machines the Z measurement begins at the end of the fully retracted

tool spindle rather than at the origin point of the coordinates. A programmer can then, in the normal manner, consider depth measurement from the surface of the workpiece.



Fig. 3—Two dimensional Point-to-Point turret drill with X and Y axis controlled by either punch tape or decade console just below operator's right hand. The Z axis or depth

that each tool travels is determined by manual stops that are set prior to running a job. Upon command the work table moves to the proper location under the cutting tool.

values for both X and Y. Nearly all combinations of machine tools and control systems confine position designations to this quadrant so that a programmer can work with all positive numerical instructions.

If we imagine the upper right hand quadrant as the workpiece and want a hole drilled where the X value of 3 and the Y value of 4 intersect, the spindle is actuated by the programmed control unit and proceeds to that location and drills the hole. In moving to this location

the cutting tool is naturally above the surface of the workpiece. This is a very typical operation performed on a point to point type machine tool. In this instance the drill spindle may have moved first along the X axis and then the Y to get to the X3, Y4 location. It may have moved in just the opposite manner or it may have moved on a diagonal. Most machines are designed to take the shortest and quickest route from one point to the next. If the hole depth in this illustration is pro-

"The depth is controlled by mechanical stops."

grammed through the control unit, its measurement is known as the Z axis. Figure 2 is an illustration of three dimensional Coordinates.

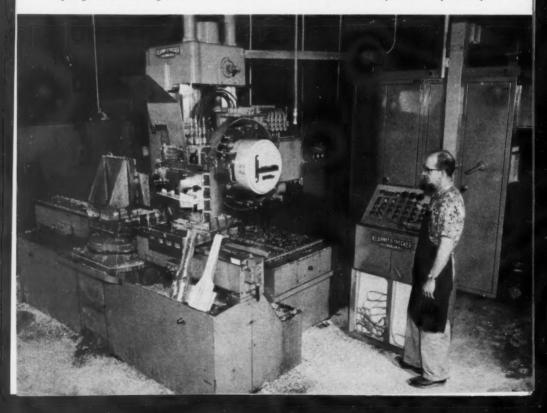
A typical continuous path operation can be illustrated in Fig. 1 by assuming a slot is to be milled from the origin point in a straight line to the value of X3 Y4. Both the X and Y motions occur simultaneously and at a 3 to 4 ratio. By varying the travel ratio and direction, various configurations could be milled.

Whether point to point or continuous path, a machine tool may

be numerically controlled on two. three, four, five or more axes. Most frequently a two axis machine is controlled on its X and Y axes. The depth to which the cutting tool would go is controlled by mechanical stops, a limit switch or otherwise. A machine of this type may also be known as a two dimensional or 2-D type. A three axis machine is most frequently controlled on its X, Y, and Z axes. Four, five, or six axis machines have controlled movement in the tilt and swivel of the head, tilt of the table and varying degrees of indexing of the table.

Fig. 4—Point-to-Point machine with 30 station tool changer. Surface milling may also be done along X or Y axis. These axes plus plunge of tool along Z axis are controlled

by punch tape program. Other functions including flow of coolant, selection of tools from changer, indexing of table, and feed rates are controlled by means of punch tape.



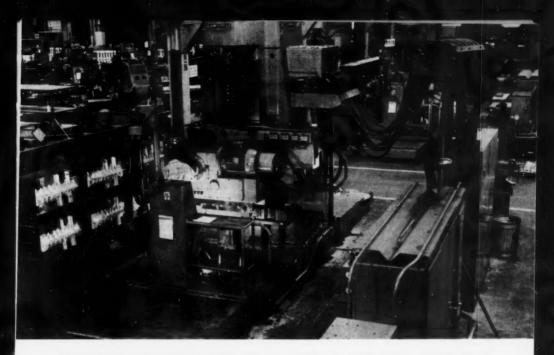


Fig. 5—Continuous Path profile mill utilizing punch tape input with full control along all three axes. By moving simultaneously on two or three axes intricate configurations can be

readily sculptured. In this particular illustration, as one workpiece is finished a new part can be mounted for machining while work is accomplished on a succeeding part.

Various types of numerically controlled machine tools are shown in Figs. 3 to 6. Numerous capabilities are often common to many different machines but usually from the more sophisticated to the simpler type unit. For that reason a close scrutiny should be given to potential future requirements so that additional work loads can be integrated into a versatile unit rather than having to purchase additional versatility in an entirely new unit.

In addition to the point to point and continuous path classifications, there are cycle program and tape template. An example of a cycle programming is a stretch press in which there is a series of cycles such as picking up a piece of sheet metal and giving it a certain number of stretches over a die and then stacking it.

A riveting machine whose head travels along one axis and is controlled by a length of tape following the head is a typical tape template machine. As the tape follows the head it is pulled across a sensing unit and every time a hole appears in the tape a rivet is driven. If a rivet is to be placed every six inches there will be a hole spaced six inches apart on the template tape.

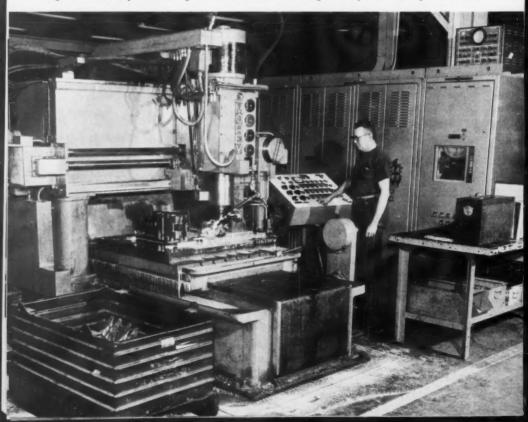
The four numerical control classifications, point to point, continuous path, cycle program and tape template, were established by the Aerospace Industries Association which association has been diligently working to establish certain types of standards for numerical control.

"Binary numbers are based on powers of two . . ."

While it is not necessary to know the theory of binary numbers, greater understanding of how control systems function is possible since this method of handling numerical quantities is employed in computers and control systems. Binary numbers are based on powers of two instead of ten. This enables any numerical quantity to be expressed with not more than two different digit designations. Those normally used are 1 and 0 although a square and diamond or any other two different shapes or marks could be used. Binary notations are used

since electrical circuits are stable on two conditions; charged or discharged, on or off, conductor or non conductor, positive or negative and so on. A punch tape either has a hole in a specific location or it does not. Numerical values expressed as binary notations can be added, subtracted, multiplied, or divided the same as our familiar ten digit system. Tape preparation units and computers accept their instructions in our familiar arabic system and then convert them to binary form for all computations. The programmer does not have to make the

Fig. 6—Vertical profiler using 14 channel one inch magnetic tape as the input medium.



BINARY NUMBERS

ARABIC BINARY	POWERS OF 2	
0 0 0 1 1 2 10 3 11 4 100 5 101 6 110 7 111	20	Value of 182 expressed in Arabic numbers
7 111 8 1000 9 1001 10 1010 11 1011 12 1100 13 1101	23	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$
13 1101 14 1110 15 1111 16 10000 17 10001 18 10010 19 10011 20 10100 21 10101 22 10110 23 10111 24 11000 25 11001 26 11010 27 11011 28 11100 29 11101 30 11110 31 11111 32 100000 64 1000000	2 ⁴	Value of 182 expressed in Binary numbers

Fig. 7—Binary numbers facilitate the rapid and accurate operation of control systems and computers since electrical devices are stable on two conditions such as charged or

conversion. Figure 7 illustrates the binary principle.

Control systems for point to point machines utilizing the Electronic Industries Association standard eight channel, one-inch punch tape discharged, on or off, and so on. The conversion from Arabic to Binary is accomplished in a control system or computer. This work is not performed by the programmer.

almost universally use the EIA Standard Binary Coded Decimal or BCD system of punching. A large portion of continuous path units with punch tape as the input media also use the BCD system. Five of

". . . any numerical quantity from 0 to 9 can be designated."

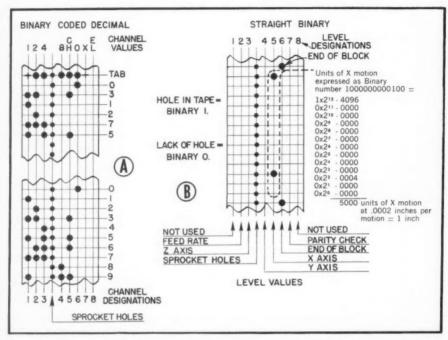


Fig. 8A-Sections of EIA (Electronic Industries Association) standard Binary Coded Decimal Punch tape. The BCD system of punch codes is used in nearly all point to point systems and in a large portion of continuous path machines. From the left side of the tape the first six channels carry values of 1, 2, 4, 8, CH and 0 respectively. The CH or parity check channel is utilized to make certain that an odd number of holes (not counting sprocket holes) appear in all rows across the tape. The X value channel is used to designate miscellaneous functions or is used in conjunction with alphabet codes. The EL is the end of line channel. The section of tape with the 03.1275 code is a typical designation for an X or Y axis position. The control system in this instance would require

that such a designation be expressed in six numbers with the decimal position understood, but not actually indicated, as being between the second and third digit. Fig. 88-Some continuous path control systems utilize a straight binary code system. Axis designations and feed rates run the length of the tape in certain channels. A binary number in a given block of information indicates total units of motion. In the above example 5000 units of motion of 0.0002 each would be required to total one inch. The value of binary notations can readily be seen since a hole in the tape equals a binary 1 and the absence of a hole is a binary O. This particular method of coding is almost always the result of a computer developed program. It does not lend itself to manual program make up.

the eight channels are assigned values 0, 1, 2, 4, and 8 so that any numerical quantity from 0 to 9 can be designated on one horizontal

level of the tape. A seven is a combination of the 4, 2, and 1 holes. A 3 is a combination of the 2 and 1 punches and so on. The decimal

value of any number is determined by its relative position within a given numerical quantity. As an example, a control system may require that any X axis designation be stated in six figures with the first two being the numbers to the left of the decimal point and the next four going to the right of the decimal. Hence we get Binary Coded Decimal. Figure 8 at (A) shows the coding of a typical X axis number 03.1275.

Straight binary, used in a number of continuous path control units, provides for each axis or function such as feed or speed designation running the length of the tape in a specified channel. If, for example, the minimum movement along any axis is 0.0002 inch it would take 5000 units of motion along the axis to equal an inch of travel. Figure 8 at (B) shows a sample block of straight binary punch tape. The use of this type of coding is practically always limited to computer developed programs.

The actual programming techniques for point to point machines will be the subject of next month's article in this series. Following this will be a description of continuous path programming with its alternative methods.

★ modern machine shop ★

Strain Recording. An 8½ by 11-inch 20-page illustrated booklet entitled "Strain Recording with Brush Direct Writing Recorders" is now available from Brush Instruments, Division of Clevite Corporation, 37th and Perkins, Cleveland 14, Ohio. This booklet describes the

application of strain gages and strain gage based transducers for accurately recording strain, tension, thrust, load, torque, and so on. Basic strain recording circuits are shown for recording from one, two, or four-active gages, and techniques used to obtain precise recording of both static and dynamic strain phenomena are explained. Also described are circuits for temperature compensation and for elimination of errors in Wheatstone bridge circuits. Various types of strain gages are presented and an appendix provides a guide for the selection of specific gages. Illustrations include approximately 40 photographs, circuit charts and diagrams.

Copies of the new booklet are available at a price of \$1.00 each.



"Congratulations on being the most wideawake man in the shep, Wilton . . . I've counted 25 coffee-breaks since noon!"

PRODUCTION



Automatic Machine Deburrs Tube Ends

The difficult job of deburring cut-off ends of rectangular and circular steel tubing is being performed with speed in a Midwest fabricator's plant on a novel machine designed specifically for the task. The Lo-Die Tube End Finisher being used was developed by the Lordstown Tool and Die Company, Inc., Warren, Ohio, in cooperation

with abrasives engineers of Behr-Manning Co., a division of Norton Company.

The tubes, mainly of mild steel, are loaded on a moving carriage, adjustable in width to match the length of the workpieces, by an operator standing at one end of the machine. Ragged ends of the tubes are cut off by the two 20-inch resinoid-bonded Norton wheels using 60-grit aluminum oxide as the abrasive; a second workman unloads



This illustration shows the Lo-Die tube end finisher loaded with flat transformer tubing. Floor-mounted rails permit adjustment of width to match the length of workpieces handled.

154

THROUGH



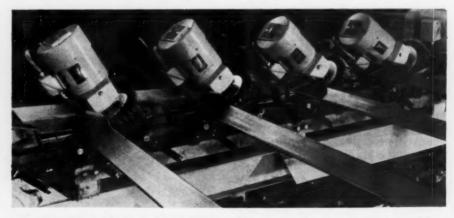
MODERNIZATION

the pieces at the other end of the machine.

At the rate of seven to nine pieces per minute, the tube sections pass between eight Vonnegut heads—indexing wheels loaded with 80-grit aluminum oxide abrasive cloth bonded with an all-resin adhesive. The cloth abrasive is slitted from hub to outer edge at ½-inch intervals; face width of the wheels is 4 inches. These heads are rotated at 1200 r.p.m. by 2 h.p. gear reduction

motors, and are angled to produce the most effective deburring action on both inner and outer surfaces. Alternate heads rotate in opposite directions.

Unique work-holding fixtures on 12-inch centers are versatile enough to hold flat transformer tubing, square sub-floor ducting or circular tubing with equal security. To do it, each tube end is held between a fixed bracket and a movable arm which grips the part under spring



Unique brackets on 12-inch centers hold tubing of any shape. The cloth abrasive heads deburr inner and outer surfaces of the tube ends. Alternate heads rotate in opposite directions.

more production . . .

pressure. Working width of the machine varies from 42 inches to $155\frac{3}{4}$ inches and is adjusted by a powered worm.

As installed in the fabricator's plant, each machine is housed in a corrugated steel shed, and is equipped with a complete dust collection system. The production rate attained with this machine and its two men greatly exceeds that of the former method.

For more data circle 1 on Postpaid Card

* modern machine shop *

Improving Weld Quality on Motor Switch Parts

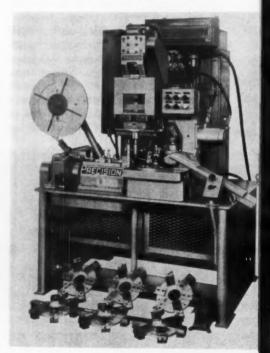
A "tape" welder at the Lima (Ohio) Small Motor Division of Westinghouse Electric Corporation achieves manufacturing versatility with interchangeable dial-index fixtures that allow for welding electrical contacts to a variety of parts for motor starting switches. Designed and built by Precision Welder & Flexopress Corporation, Cincinnati, the unusual machine is basically a standard Precision PVB-1 magnetic force bench welder, highly automated with handling, blanking and forming devices.

The machine forms electrical contact buttons from a roll of monel-backed silver tape. A reel feeds the silver tape through measuring, cut-off and forming stations. Then the mechanism presents the contact buttons, properly oriented, to the welding stations, where they meet other switch parts on the dial-index table, and are magnetic-force weld-

ed at rates ranging up to 2,600 per hour.

After welding, the assemblies index to a forming station which coins the contact buttons to final spherical shape. At the following station, an air jet ejects the assemblies down a chute into a storage container.

The welder has approximately tripled the production rate of motor switch assemblies. It has other advantages as well. Original tooling for the machine included seven interchangeable dial-index table tops for as many different parts. New table tops can be added as needed to accommodate switch de-



Tape welder at Westinghouse Lima Small Motor plant has seven interchangeable dialindex tables for differently shaped parts.



LIVE CENTERS



UNIVERSAL models for super accuracy to .0001, high load capacity, perfect for grinding and other high-precision work



meet most turning needs at lowest center point cost

> Over 40 sizes ... with all popular tapers ... in four styles . . . to choose from. That's how Ideal helps you meet your turning needs for the heaviest work to the lightest of light jobs.

Ideal Live Centers are guaranteed to provide the highest accuracy required, exactly matching the lathe size you use. What's more, they are custom quality designed and manufactured by production methods to give you the lowest possible precision center point costs.

You can get Ideal Live Centers from your distributor's stocks. He'll give you immediate delivery service-which reduces your inventory requirements and cuts your investment costs. If you need a special, we'll be glad to work with him to meet your specifications at the right price.

MULTI-DUTY models for general use. perfect for light work, interchangeable parts provide quick changeover for



extra rugged work, give close tolerance results where high load capacity



PIPE POINT models for cylindrical turning of pipe, axles and other hollow shapes, six sizes from 31/4" to 71/2" dia.

SOLD THROUGH LEADING INDUSTRIAL DISTRIBUTORS In Canada: IRVING SMITH, Ltd., Montreal

Write for new LIVE CENTER Catalog

IDEAL INDUSTRIES, Inc., 1031-J Park Avenue • Sycamore, Illinois

For more data circle 417 on Postpaid Card



PRODUCTION-MINDED and PRECISE

The NEW Hamilton-Varimatic Super Sensitive Drilling Machine is, by far, the most accurate, most rigid Varimatic we have ever built.

Mechanism, self contained, super sensitive, precise, swings radially on the column and locks at any desired station.

Base is longer, wider, heavier than ever before. Column collar is taller and heavier for more rigid support of working unit. New design of motor mount features extra reinforcing, and this, plus a new electrically and dynamically balanced Machine Tool Motor all but eliminates vibration.

Spindle speeds are infinitely variable. A simple adjustment of the graduated hand wheel selects any desired spindle speed between 840 and 2700 R.P.M., or between 2900 and 9300 R.P.M.

GET THIS!

Bulletin No. 2955 provides complete description, includes sectional drawing, lists features, gives specifications. It's free for the asking. And we'll be glad to have you ask.

THE HAMILTON TOOL COMPANY

828 SOUTH NINTH STREET HAMILTON, OHIO

For more data circle 418 on Postpaid Card
158 MODERN MACHINE SHOP

more production . . .

sign changes or entirely different classes of parts.

Tolerance requirements on these electrical assemblies are critical. The buttons have to be located exactly, and be formed to proper contour. Welds must be strong and consistent. The welds are performed on a variety of materials: steel, brass, beryllium-copper and silver. For more data circle 2 on Postpaid Card

* modern machine shop *

Chilling Machine Tests Automotive Parts

Designed especially for low temperature testing of automotive electrical parts, the 9 cubic foot

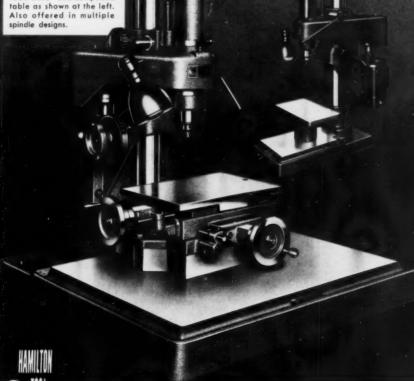


Chilling machine used for testing electrical parts at Ford Motor Company of Canada.

PRODUCTION-MINDED and PRECISE

The Hamilton-Varianetic, a radial type drilling reachine with super sensitive feed, produces small holes to 5/16." did J with instrument practision— at production speeds, spinale speed is infinitely variable in two ranges between 840 R.P.M. and 9300 R.P.M. Fer detailed infernation send the reaching add as the facilian adds.

The Varimatic is available with conventional base and work table, or with "tool-room base" and compound table as shown at the left. Also offered in multiple spindle designs.





THE HAMILTON TOOL COMPANY

828 SOUTH NINTH STREET

HAMILTON, OHIO

For more data circle 418 on Postpaid Card

October, 1961

MODERN MACHINE SHOP

159

more production . . .

stainless steel chamber shown herewith, product of Cincinnati Sub-Zero Products, 3930 Reading Rd., Cincinnati 29, Ohio, is now in use in the test laboratory of the Ford Motor Company of Canada. The chamber is a modification of the type used extensively in the aircraft industry for the environmental testing on electronic components.

The cabinet is equipped with 1inch diameter ports and 50-ampere terminals, and observation of the illuminated chamber is made possible by a 12 x 24-inch multipane, frost-free window mounted in the door. The chamber measures 20 inches high x 20 inches wide x 20 inches deep. Low temperatures are adjustable to minus 80 degrees F. with a capacity of 1000 B.T.U. per hour and accuracy of plus or minus 1 degree Fahrenheit.

For more data circle 3 on Postpaid Card

* modern machine shop *

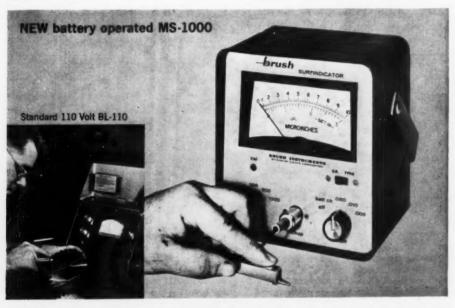
Production Checking of Gear and Spline Leads

The Model 1218-A lead checker shown here is used in production to check lead on gears and splines made by Sundstrand Aviation, a Division of Sundstrand Corporation. Work inspected on this checker, developed by Michigan



Operator is shown inspecting external helical gears for jet-engine starter turbines.

with THE BRUSH SURFINDICATOR "meeting specs" is just part of the pay-off...



An Ohio missile-parts maker* knows why. His Surfindicator not only eliminates surface rejects but also cuts machine downtime 60%. Quick, accurate tool checks . . . at his machines . . . insure optimum tool changes to greatly extend productive tool life. Anyone, anywhere can measure any finish from 1 to 1000 microinches with a compact, portable Surfindicator. Choose the standard model or the ultimate in portability, the new battery powered, completely self-contained, 5½ lb. MS-1000. Ask your nearest Brush distributor for a demonstration. Write for our new booklet . . . 16 pages on how Surfindicator improves profits in five major operating areas . . . production, tooling, engineering, quality control and research. *name on request*

37TH AND PERIONS

CLEVITI

CLEVITE CLEVELAND 14, OHIO

more production . . .

Tool Co., Detroit, varies from external helical gears for jet-engine starter turbines (illustrated) to internal splines. The 1218-A is capable of repetitive accuracy within 0.0001 inch. Every check is automatically recorded on a paper chart.

An important feature of this lead checker is the optical system—which is independent of operator "feel"—used to set the universal sine bar to within 0.001 degree of the required angle. This feature was designed to improve set-up accu-

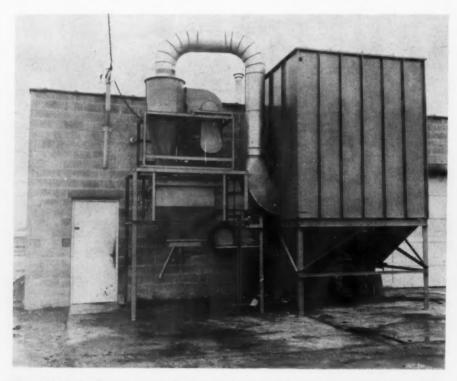
racy of the lead checker in a gear laboratory but is especially important in this production application where high-speed checking is absolutely essential.

For more data circle 4 on Postpaid Card

* modern machine shop *

Standard Dust Collecting System Solves Grinding Dust Problem

Use of a stock dust collecting system to solve a combination of critical, specialized production



The stock dust collecting system shown herewith is used to filter exceptionally fine carbon dust from a battery of eight grinding machines, as well as to recirculate the filtered air.

problems has been announced by Aget Manufacturing Co., Adrian, Michigan. The installation reguired the effective filtration of exceptionally fine carbon dust from a battery of eight grinding machines, as well as the re-circulation of the filtered air, in order not to disturb the delicate balance of heating and air conditioning units.

Equipment used for this particular job was the standard Aget Model 50N70PL Dustkop, FH58-2 Filterkop together with the HS-1, one cubic yard Aget hopper and stand. The high efficiency factor of the Dustkop unit resulted in over 95 percent of the carbon dust being deposited in the large hopper. The remaining dust is removed in the Filterkop and the clean air re-circulated in the plant, without affecting the cooling and heating systems. The dust residue is deposited in the hopper which, because of its exceptional capacity, is said to require emptying only at infrequent intervals.

For more data circle 5 on Postpaid Service Card

STANDARD'S Center-Cutting END MILLS ...

Built **TOUGH ENOUGH** for tough metals

. . . whether it's plunge or traverse cutting . . . profiling . . . cavity milling . . . die sinking or conventional slot milling, STANDARD'S END MILLS perform longer, more efficiently, with a finer work finish on difficult machining operations.

. . . Call the STANDARD Distributor in your area, he will show you a variety of TWO-, FOUR- and SIX-FLUTE, Double or Single End Mills . . .

MORE metal . Standardize

removed at . with STANDARD LESS COST . Quality!



For more data circle 420 on Postpaid Card

more production . . .

Metallized Truck Hubs Outlast Original Parts

Rebuilt diesel truck hubs, having bearing surface i.d.'s spray metallized with Colmonoy C-290 crankshaft powder, are lasting 3 to 5 times longer than original cast steel parts in a northern California logging operation. The metallizing application is performed by Consolidated Machine & Tool Co., Oroville, California.

Hubs are rebuilt when worn from 0.010 to 0.040 inch on the i.d. of the surface that supports the bearing race. They are first steam cleaned to remove all grease, grit and other foreign matter. The hub is mounted

in a lathe and the i.d. is machined oversize as required to remove all scoring and other signs of service abuse. Machining oversize up to 0.080 inch per side is permissible; sprayed overlays up to this thickness have proved most satisfactory.

Following grit blasting to roughen the bearing surface i.d., the hub is mounted in a special rotating fixture, as shown in the accompanying illustration. Colmonoy C-290 powder is applied by spray metallizing using the Spraywelder pistol handheld. The powder is fed under air pressure through an oxyacetylene flame at the pistol nozzle. Gradual build-up as the hub rotates assures optimum uniformity of overlay thickness and surface temperatures during spraying.

For more data circle 6 on Postpaid Card



Colmonoy C-290 metallizing powder is applied with a Spraywelder pistol to the bearing surface i.d. of a truck hub as it rotates in a

special fixture. Reclaimed hubs with bearing surfaces rebuilt by metallizing are claimed to outlast 3 to 5 original cast steel parts.

He's making a Monarch Lathe...



One example of where the extra values come from—in your MONARCH Lathes

You never saw this flame-hardening procedure until Monarch perfected it. But for many years, it has produced lathe beds without equal for sustained hard use, with retained original accuracy. Yes, this man is making a Monarch lathe in the truest sense. His job, typically, consists of building into all Monarch lathes the intrinsic, exclusive features that become your ultimate dollar's worth.

As a result, you can expect your modern Monarch to so lower costs that, after paying for itself out of savings in a 3 to 4 year span, it will continue to benefit your competitive stance for years. How? By increasing production; by lengthening tool life; by delivering such accuracy and finish as to cut considerably—or eliminate—finishing operations.

What more can your capital expenditure dollars buy? Everyone in your organization concerned with such decisions should be familiar with our story—which we'll gladly send. . . . THE MONARCH MACHINE TOOL COMPANY, SIDNEY, OHIO.



WHEN YOU BUY VALUE MONARCHS COST LESS



VISIT MONARCH-We'll turn your part to return you profit

For more data circle 421 on Postpaid Card



ALL the features you want in 4-way, pilot-operated air control

HOW FAST? So fast it fills 12 cu. in. test chambers from 0 to 90 psi in 0.029 seconds. Larger, 100 cu. in. chambers fill in 0.075 seconds. Valve itself has been cycled on test over 3,000 times a minute. We know of no faster valve.

HOW SURE? Valve will operate on severely restricted air supplies and at pressures down to 15 psi, thanks to a reserve volume of pilot air, maintained at maximum line pressure in a self-restoring accumulator chamber (patent applied for). Low-wattage, nylon encapsulated, plug-in solenoids are guaranteed for life against burnout, New "Comb-O-Seals" - onepiece, pressure-energized-seal positively, cannot be improperly assembled. Any of today's varied air line lubricants can be used. Both pilot valve and main valves operate on poppet principle, cannot stick in

HOW GOOD? Good for millions of leak-proof cycles! All-aluminum, die cast construction gives you light weight, assures clean, smooth air passages. Base mounting-all connections, air and electrical, are mounting—all connections, air and electrical, are permanently made to the base. Quick plug-in feature —entire operating unit "plugs" into base: remove two screws and it lifts off easily and quickly. Locking manual over-ride is standard on all solenoid models. All models fully meet J.I.C. standards.



ADD-A-FOLD BASES (optional) permit joining a number of valves together, with one supply,

one exhaust, one gallery for electrical connections.

You can have either maintained or momentary contact electrical actuation-or remote pressure actuation. Valve is available in 34", 34" and 34" pipe sizes. Write for new Bulletin 0611-B1.

PARKER-HANNIFIN

HANNIFIN COMPANY DIVISION

565 South Wolf Road . Des Plaines, Illinois EUMATIC AND HYDRAULIC SYSTEM COMPONENTS

EUROPEAN DIVISION - PARKER HANNIFIN N. V. - SCHIPHOL - THE NETHERLANDS

For more data circle 422 on Postpaid Card

HANNIFIN

MOUNT ON

31/4" CENTERS



Namco DBS Vers-O-Tool gives... 50 times more pieces per grind

... for Stevens Manufacturing Company

When Stevens Manufacturing Company, Lexington, Ohio equipped a Brown & Sharpe No. 2 automatic with a NAMCO \(\frac{3}{6} \) DBS Vers-O-Tool, the increased threading efficiency was astonishing. On the part shown, pieces-per-grind soared from an average of 1000 to 50,000; scrappage dropped 90%; production increased by 2\(\frac{1}{2} \) times; tolerance trouble became a thing of the past. Stevens finds such performance typical for the DBS. A non-revolving threading tool, it's designed specifically for B & S automatics; has an exclusive automatic opening and closing mechanism for unmatched precision in cutting close-to-shoulder threads. Available capacities are shown below. Thousands of manufacturers use NAMCO threading tools to slash threading costs and improve thread quality. Our 44 page bulletin DT-60 will give you all the details. Get in touch. We'll be happy to send you a copy.

Size Die Head Inches	Brown & Sharpe Machine Size;	Straight Threads		Adjustment for Diameter		Capacity	Coarsest
		Min. In.	Max. In.	Minus	Plus	Threads Inches	Standard Pitch
DBS 1/4 *DBS 1/4 *DBS 1/4	No. 00-0- 00G-0G No. 0-0G-2 No. 2	.056 % %	54 36 96	.031 .071 .068	.004 .012 .020	56 36 56	18 16 11

Chasers and blocks interchangeable with % DR and %* DS die, †Chasers and blocks interchangeable with %* DR and %* DS die, †And corresponding BSA sizes. Larger capacity Vers-O-Tools for B & S and BSA machines can be furnished on application.



Aluminum expansion tube for Stevens Type M adjustable thermostat. Thread specifications: class – 2; pitch – 56, diameter – 5/6", length – 15/6", tolerance ± .010 (actual size)

National Acme acid Colepany In the National

Sales Omices: Name 2, N. S., Cincago e, M., Della

For more data circle 423 on Postpaid Card

IDEAS FROM READERS



Jeweler's Saw Cuts Thin Walled Tubing

By GILBERT C. CLOSE

In producing heat exchanger components for the DC-8 jet transport airplane at the Long Beach, California Division of Douglas Air-

(Above) Top view of assembled saw table. Scrap extrusion material can be used. Note slide and cutting guide to assure a square cut. Saw height need not be adjustable as only one diameter of tubing (1/4 inch l.D.) is cut. (Below) Underside view of the saw table. This portable unit can be readily connected to any convenient plant air outlet.

craft Company, it is necessary to cut hundreds of short lengths of $\frac{1}{4}$ -inch I.D. aluminum tubing of only 0.006-inch wall thickness. Attempts to cut this foil-thin material on conventional tube cutting equipment resulted in crushing and excessive burring.

The problem was solved by constructing the small, portable tube saw shown in the accompanying illustration. The unit is powered by an air motor which operates at about 20,000 r.p.m., driving a very thin, fine-toothed conventional jeweler's saw blade. Details of the miniature saw table (which could be varied to suit peculiar requirements) are clearly shown. With this saw, the thin-walled tubing cuts cleanly, without crushing and with minimum burring.

* modern machine shop *

Tool for Removing Bushings

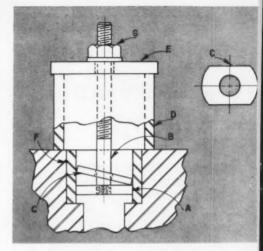
By L. KASPER

The drawing illustrates an easily made tool which is designed to remove bushings which have been

forced into blind holes or against shoulders. Such bushings are difficult to remove as the conventional type of puller cannot be inserted in back of them.

The disc A, which is slightly smaller in diameter than the inside diameter of the bushing, F, is attached to the stud, B. The gripping plate, C, which is slightly larger in diameter than the inside diameter of the bushing, is shaped as shown and is a loose fit on stud, B. so that it can be tilted to an angle of about fifteen degrees. A piece of tubing, D, and a plate, E, complete the tool.

In use, disc, A, and plate, C, on the stud, B, are inserted into the hole in the bushing, F, and, when the nut, G, is turned, the disc, A, endeavors to bring the plate, C, into a parallel position, causing it to wedge tightly in the bore of the



Easily made tool for removing bushings.

bushing. The tighter the bushing is positioned in its hole, the tighter will be the grip of the plate, C.



UNIQUE FEATURES

- Extended nose spindle . . . carbide tipped
- · Life-time lubricated, pre-loaded ABEC-7 ball bearings
- · Spring compensation to .020" axial movement without impairing accuracy
- · Heat treated, stainless steel construction
- · Hexagonal anti-roll shoulder

Vee-Arc Super-Precision Live Centers are also AVAILABLE THROUGH YOUR MONARCH AND CINCINNATI

LATHE DISTRIBUTORS

WRITE FOR BULLETIN 1282A DIRECT TO VEE-ARC CORPORATION, DEPT. MM, WESTBORO, MASS., U.

For more data circle 424 on Postpaid Card

production short-cut idea

HEAT-TREAT SMALL PARTS, TOOLS, DIES, ETC., WITH A VERSATILE, HIGHLY EFFICIENT TEMCO FURNACE

Why tie up your big equipment on small heat-treat jobs below its capacity? Put a TEMCO bench-type electric furnace in your shop and see how it pays for itself over and over again—in timesavings, costsavings, and production conveniences. Shown above is Type 1600 Furnace with TEMCOMETER-type controller in new cabinet assembly.

TEMCO Furnaces are economical to own and operate . . . easy to hook up . . . easy to use. Thirty models with chamber sizes from $4'' \times 334'' \times 414''$ to $10'' \times 9\frac{1}{2}'' \times 22''$, \$80.00 to \$1200.00 complete with controls. Write for literature and name of nearest dealer.



ELECTRIC FURNACES THERMOLYNE CORPORATION

(Formerly Thermo Electric Mfg. Co.)
488 Huff St., Dubuque, Iowa

For more data circle 425 on Postpaid Card

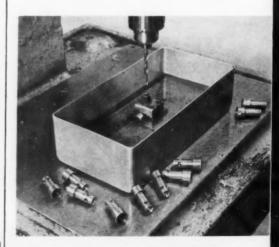
ideas from readers . . .

Submerged Drilling Improves Hole Finish

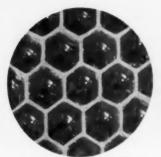
By H. J. GERBER

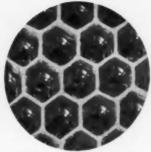
On some types of work we have found that drilling operations are considerably improved if the process is performed while the work is completely submerged in coolant or cutting oil. As an example, the small non-ferrous sleeves shown here being jig drilled were previously both drilled and reamed to hold the required size and surface finish. After adopting the submerged drilling method, we were able to produce holes of required accuracy and excellent finish by just drilling alone.

In this job the small jig was screwed to the bottom of the pan which holds the cutting oil. This is desirable to prevent chips from lodging under the base of the jig.



Submerged drilling of non-ferrous sleeves.







POSITIVE DUPLICATION — EVERY TIME!







One of nature's enduring, dependable marvels is the structure of honeycombs—formed exactly the same way time after time after time. This is Positive Duplication—yours also with these CINCINNATI CENTERTYPE GRINDING WHEELS, and with all CINCINNATI ® ° WHEELS.

HOW "PD" IS ACHIEVED

To produce grinding wheels of unsurpassed uniformity, Cincinnati developed its unique manufacturing process, involving 36 quality controls. These rigid controls govern every step of wheel production. They achieve, for example, tolerance for wheel inside diameters which are the "tightest" in the industry. So your CINCINNATI WHEELS have better balance, require less dressing and last longer.

HOW "PD" PAYS OFF FOR YOU

The uniformity and longer wheel life you get permits you to plan production schedules with the assurance that each reorder wheel will act and grind exactly like the original. This is the promise—and performance—of Positive Duplication.

CUT COSTS...CALL CINCINNATI NOW

You can solve your grinding problems with the help of specialists trained by the Cincinnati Milling Machine Co. Their wide experience in job set-ups and grinding operations is at your service. Just call your CINCINNATI GRINDING WHEELS Distributor or contact Cincinnati Milling Products Division, Cincinnati 9, Ohio.



*Trade Mark Rea, U.S. Pat. Off

A PRODUCTION-PROVED PRODUCT OF THE CINCINNATI MILLING MACHINE CO.

For more data circle 426 on Postpaid Card

October, 1961

MODERN MACHINE SHOP

169



Use Postpaid Cards opposite Page 32

Boring and Drilling Machine

American Tool Works Co., Pearl St. at Eggleston Ave., Cincinnati 2, Ohio. Bulletin 813-A, in color, describes applications and specifications of a 19 inch column traveling openside tape controlled boring and drilling machine.

For more data circle 7 on Postpaid Card

Surface Grinder

Landis Tool Co., Waynesboro, Pa. Catalog 618H-61 illustrates and describes Landis 618 Hydraulic Precision Surface Grinder.

For more data circle 8 on Postpaid Card

Heavy Duty Lathe

R. K. LeBlond Machine Tool Co., Madison at Edwards Rd., Cincinnati 8, Ohio. Bulletin HD 461, in color, describes and illustrates LeBlond 4025 NK Heavy Duty Lathe. Specifications are also listed. For more data circle 9 on Postpaid Card

Cylinders

S-P Mfg. Corp., 30201 Aurora Rd., Cleveland 39, Ohio. Bulletin 10C describes Series A2 Pneumatic and Hydraulic Cylinder Line. For more data circle 10 on Postpaid Card

Alloys

Ampco Metal, Inc., Box 2004, Milwaukee 1, Wis. 12-page Bulletin G-61 describes 42 of Ampco's specifications bronzes plus heat treated variations. The alloys are classified in eleven basic categories which include commercial aluminum bronzes, tin bronzes, manganese bronzes and high conductivity alloys.

For more data circle 11 on Postpaid Card

Abrasive Cutting Wheels

American Chain & Cable Co., Inc., Allison-Campbell Div., 931 Connecticut Ave., Bridgeport 2, Conn. Bulletin DH-214A gives details on the complete line of Allison Wheels.

For more data circle 12 on Postpaid Card

Milling Machine

Index Machine Co., 544 North Mechanic St., Jackson, Mich. 4-page descriptive brochure is packed with facts on new Model "645" Heavy Duty "55" Vertical Mill and Model "60" Horizontal Mill. For more data circle 13 on Postpaid Card

Drill Jig Bushings

Accurate Bushing Co., 447 North Ave., Garwood, N. J. Bulletin KB-59, in color, gives complete information on bushings for use in castable or ductile materials and wood.

For more data circle 14 on Postpaid Card

Plastic Marking Process

Acromark Co., 9 Morrell St., Elizabeth, N. J. Illustrated brochure suggests basic simple approaches to the marking of plastics by hot stamping and inking methods and gives numerous tips relative to such marking.

For more data circle 15 on Postpaid Card

Bar Machine

American Bechler Corp., 28 Harbor St., Stamford, Conn. Bulletin AR-60, in color, gives information on Bechler Model AR-10 Swiss Automatic Bar Machine. Specifications are also given.

For more data circle 16 on Postpaid Card

FREE LITERATURE

and Inside Back Cover for requesting free copies of literature listed below.

Band Saw

Covel Mfg. Co., P. O. Box 116, Benton Harbor, Mich. Bulletin 159EX, in color, illustrates and describes the Excel Power Metal Cutting Bandsaw in either portable or stationary models. Specifications are also included.

For more data circle 17 on Postpaid Card

Furnaces

Lindberg Engineering Co., 2321 West Hubbard St., Chicago 12, Ill. Bulletin 1081-A, in color, illustrates and describes gaseous and solid diffusion furnaces. Specifications are also included.

For more data circle 18 on Postpaid Card

Diamond Dressing Tools

Koebel Diamond Tool Co., 16641 East Warren, Detroit, Mich. Catalog No. 861, in color, illustrates and describes the CDP (Cemented Diamond Particles) Diamond Dressing Tools.

For more data circle 19 on Postpaid Card

Drill and Reamer Holder

Boyar-Schultz Corp., 2020 South 25th Ave., Broadview, Ill. Flyer, in color, illustrates and describes Boyar-Schultz Universal-Adjustable Drill and Reamer Holder. Prices are also included. For more data circle 20 on Postpaid Card

End Mill and Die Sinking Cutters

Tomkins-Johnson Co., Jackson, Mich. Catalog No. 661, in color, contains complete line of metalworking cutters, as well as informative data and numerical charts to aid the metalworking engineer in his cutting problems.

For more data circle 21 on Postpaid Card

Shafts

Adams Company, Dubuque, Iowa. Circular No. C-114 discusses shafts, plain, keyed, splined, serrated or with integral gears.

For more data circle 22 on Postpaid Card

Tana

Besly-Welles Corp., 120 Dearborn, South Beloit, Ill. Catalog No. 804 illustrates and describes standard and special taps. Also included is a tap users guide, trouble shooting section, resharpening instructions, and handy tables on thread constants, acme threads and drill diameters, as well as a glossary of terms.

For more data circle 23 on Postpaid Card

Drilling and Tapping Units

Hypneumat, Inc., 647 West Virginia St., Milwaukee 4, Wis. Bulletin 6100 contains technical information, specifications, drill thrust charts, tapping-threading data, typical circuits and applications for the drilling and tapping units of the Hypneumat Line.

For more data circle 24 on Postpaid Card

Hydraulic Presses

Dake Corporation, 612 Robbins Rd., Grand Haven, Mich. Bulletin 415, in color, illustrates and describes the Dake Hydraulic Drawing and Forming Press. Specifications are also included.

For more data circle 25 on Postpaid Card

Tap Extensions

Walton Co., Hartford 10, Conn. Folder No. 10 describes Walton's line of Tap Extensions.

For more data circle 26 on Postpaid Card

free literature . . .

Superfinishing

Gisholt Machine Co., Madison 10, Wis. Catalog, in color, explains Superfinish, a recognized method producing a controlled surface finish. The catalog also contains information on the superfinish tool, the operation, different jobs that can be accomplished and machines and attachments.

For more data circle 27 on Postpaid Card

Marking Tools

Consolidated Stamp Mfg. Co., Inc., Markomation Div., Spring Valley, N. Y. 14-page catalog shows a wide range of engraved steel lettering tools available for indenting, embossing, blind stamping, and so on. Complete specification pages, a removable, transparent, flexible lettering chart and a check list for ordering are also included.

ordering are also included. For more data circle 28 on Postpaid Card

Heating Machine

Cincinnati Milling Machine Co., Cincinnati 9, Ohio. Brochure, in color, describes the Cincinnati RF Inductron Heating Machine which can be used for selective heating applications such as hardening, annealing, brazing, soldering, tempering, stress relieving, shrink and so on. Specifications are also included.

For more data circle 29 on Postpaid Card

Sealant

American Sealants Co., Hartford 11, Conn. Brochure, in color, describes and illustrates Loctite Sealant, the liquid lock for metal parts. Specifications are also included.

For more data circle 30 on Postpaid Card

Boring Heads

Giddings & Lewis Machine Tool Co., Davis Div., Fond du Lac, Wis. Catalog No. D-530-A illustrates and describes the Davis Boring Heads. Specifications are also included.

For more data circle 31 on Postpaid Card

Expanding Mandrels

Erickson Tool Co., 34358 Solon Rd., Solon, Ohio. 8-page, 2 color, catalog describes Erickson's wide range of mandrel styles and sizes. Detail drawings and complete dimensional specifications are given to help users select the right mandrel for any application. Each type of mandrel accommodates a wide range of interchangeable sleeve sizes.

For more data circle 32 on Postpaid Card

Countersink and Resharpening Fixture

M. A. Ford Mfg. Co., Inc., 1545 Rockingham Rd., Davenport, Iowa. Bulletin No. 108, in color, describes H.S.S. and Carbide Uniflute Countersinks. Photographs, dimensions, specifications and prices are also included. The Unicam Resharpening Fixture is also shown in the bulletin.

For more data circle 33 on Postpaid Card

Punches and Dies

Dayton Perforators, Inc., Box 216, North Dayton Station, Dayton 4, Ohio. Catalog 604 and Pricer 605 offer many helpful suggestions on standardization, costcutting, how to specify and buy, how to avoid costly delays and complete specifications and engineering data. The material lists an expanded line of decimal sizes beyond the Kommercial Pups sizes, and adds Jektole, slug ejector punches that up to now were only available in Dayton's Versatile Line of Punches. Basic shapes in punches and headless and head-type die buttons are also included.

For more data circle 34 on Postpaid Card

Thread Rolls

Detroit Tap & Tool Co., 8615 East Eight Mile Rd., Warren, Mich. 8-page Bulletin E-61 contains stock list and prices on thread rolls. Advantages of thread rolling are enumerated along with illustrated drawings. Bump type thread rolls, straddle type and a wide range of plunge and through-feed type thread rolls are also included.

For more data circle 35 on Postpaid Card

Ovens and Furnaces

Blue M Electric Co., 138th and Chatham St., Blue Island, Ill. Miniature Catalog No. 600, in color, covers complete line of Blue M's Electric Ovens, Furnaces, Magni-Whirl Baths, Environmental Cabinets and Related Temperature Controlled Equipment for the laboratory, medical field, pilot plant and production. For more data circle 36 on Postpaid Card

Expansion Fitting Method of Assembly

Cincinnati Sub-Zero Products, 3930 Reading Rd., Dept. S-1, Cincinnati 29, Ohio. Bulletin on expansion fitting, as a time saving, reliable assembly procedure. The bulletin contains a full case history, along with photographs illustrating expansion fitting bearing raceways, and it includes tables of expansion coefficients and monograms for calculating rates of thermal expansion and determining the temperatures required.

For more data circle 37 on Postpaid Card

YOUR SAW BLADE PASS THIS TEST?

The best way to test the superiority of a Nicholson or Black Diamond blade is, of course, use. Fit one into your saw and try it. You'll know. It's the finest blade made.

But—one of the reasons for that superb performance is the Micro-Photo Quality Control Test (above). It permits constant checks on tooth formation, cant and degree of coarseness in Nicholson and Black Diamond hand hacksaw, power hacksaw and band saw blades.

Can your saw blade pass this test? It can if it wears the Nicholson or Black Diamond name.* *Industrial Distributors provide the finest goods and services in the least possible time. Our products are sold exclusively through them.

Send for our valuable text on industrial sawing techniques.

	ON FILE COMPANY e 1, Rhode Island
Gentlemen	: Please send me a free copy ok, "Sawology."
Name	
Name	



NICHOLSON



Nicholson File Company, Providence 1, Rhode Island Files * Rotary Burs * Hacksaw and Band Saw Blades Hole Saws * Ground Flat Stock * Industrial Hammers

For more data circle 427 on Postpaid Card

free literature . . .

Machine Tools

Machine Tool Div., Brown & Sharpe Mfg. Co., Providence 1, R. I. 20-page catalog presents in condensed form, specifications and illustrations of the entire line of Brown & Sharpe Machine Tools including milling machines, grinding machines, automatic and hand screw machines and turret drilling machines. Optional accessory equipment for the above machine tools are also described. For more data circle 38 on Postpaid Card

Lubricants

Macco Products Co., 9203 MM South Sangamon St., Chicago 20, Ill. Brochure, in color, is a suggestion guide for the selection of cleaners, cutting lubricants, drawing compounds, rust preventives, forging compounds and various extrusion lubricants.

For more data circle 39 on Postpaid Card

Carbide Tools

Adamas Carbide Corp., Kenilworth, N. J. Price List No. 861 gives specifications and new prices on Adamas complete line of tungsten carbide tools, tool tips, dies,

wear parts, DexA-Tools and DexA-Mills. A mong many items in the price list are positive rake and other new styles of DexA-Tools, solid carbide circular form tool blanks, rectangular reamer tips, and inserts.

For more data circle 40 on Postpaid Card

Chucks

Buck Tool Co., 814 Schippers Lane, Kalamazoo, Mich. Catalog No. 61 shows conventional independent chucks, the Buck Adjust-Tru 2, 3 and 6 jaw scroll chucks, Adjust-Tru dust proof and steel power chucks. Other Other items include the gibbed keyway aluminum body power chucks to 18 inches, jaw turning fixtures, and air cylinders. For more data circle 41 on Postpaid Card

Thread Chaser

C-H Industries, Box 125, Wallingford, Pa. Literature gives information on a tool holder capable of chasing internal and external threads.

For more data circle 42 on Postpaid Card



Gives fast, precise, highly reproducible readings on BOTH the Regular and Superficial Rockwell scales. Costs about the same, though motorized, as one single-scale hand-operated instrument. Ball and diamond indenters and 15 to 150 Kg major loads extend Riehle-Kentrall versatility. Choose 4", 8", 12" or 16" vertical capacity models, all with 5¾" horizontal reach.

For a demonstration, write Dept. MMSK-1061.

VISIT US BOOTH 429 NAT. METAL EXPOSITION

Riehle®

American Machine and Metals, Inc.

*Trademark

For more data circle 428 on Postpaid Card





S Teal Starage Boards provide space for presetting and staring two sets of tooling at the machine, ready for instant installation.

C Seibert Teel Control Units with meters to record the number of machine cycles between tool grinds. They automatically program tool changes.



All the second s



Double-Action Tap Drivers



Adjustable Adapters



Recessing Tool Holders



Drill and Tap Drivers

This symbol of efficiency can mean much to you

THG 5 C is not a name, but a combination of initials to represent an idea . . . an *important* idea for production plants which require preset tools for high efficiency, and which are seeking solutions for the following problems: (1) Accuracy and efficiency in presetting, holding, and changing tools. (2) Systematic storage of tools and gages. (3) Dependable and efficient control of tool use to prevent work spoilage, excessive down-time, tool breakage, and machine overload.

T H G S C is the symbol for Seibert Coordinated Planning, which is the engineering of a completely coordinated combination of Seibert Tool Holders, Gages and Gage Plates, Storage Units, and Control Units. Such a combination is necessary for operating production metal-working equipment at its highest efficiency and is the key to close teamwork in all operations involved in presetting and changing tools and in the control of tool use.

It is easy to learn of the advantages of Seibert T H G S C Coordinated Planning, and the best time to do so is when your production-equipment program is in the planning stage or when you are looking ahead to modernization. But we welcome the opportunity at any time to explain how this coordinated planning can reduce tooling costs, and how systematic storage of tools and gages will promote efficiency among operators and inspectors.



MeterUnits for all types of equipment. One to eight meters to program tool changes. Mount on wall or mochine.

Circular-Type Gage Plates are compact and convenient. One to six holes. Gages have interchangeable heads.







Selbort T N G S C Coordinated Planning is yours for

SEIBERT

SEIBERT & SONS, INC.



For more data circle 430 on Postpaid Card

J. H. WILLIAMS . CO.

412 VULCAN ST., BUFFALO 7, N. Y.



Conversion Chart

Northwestern Tools, Inc., 119 Hollier Ave., Dayton 3, Ohio. Conversion chart lists identical jig and fixture components which are manufactured by twelve different companies.

For more data circle 43 on Postpaid Card

Springs

Associated Spring Corp., Bristol, Conn. 16-page brochure is an aid to producers of products containing springs in controlling costs of handling, quality and procurement.

For more data circle 44 on Postpaid Card

Surface Measuring Instruments

Micrometrical Mfg. Co., 3621 South State Rd., Ann Arbor, Mich. 12-page catalog covers standard line of Profilometer instrumentation for the measurement and control of surface roughness. Detailed descriptions and specifications are included in the catalog. In addition to a complete coverage of all standard items, many special products are also illustrated and described.

For more data circle 45 on Postpaid Card



Standardize on Williams Tool Holders available in a complete range of sizes and patterns for turning, boring, threading, knurling, planing, cutting-off and side work. Correctly designed for fast, easy set-up and rigid, chatter-proof cutting.

Drop-forged from tough quality steel . . . heat-treated for added strength . . machined to close tolerances. Your Williams Distributor can also supply a full line of high speed cohalt and carbide cutters

FOR ALL REGULAR LATHE AND PLANER OPERATIONS

J. H. WILLIAMS & CO.

412 VULCAN ST., BUFFALO 7, N. Y



For more data circle 431 on Postpaid Card

DEPENDABLE ALLOY & CARBON STEEL IOIST HOOKS Recent improvements in design and

Carbon Steel Hooks the strongest, safest to specify. Each is heat-treated for maximum toughness and high impact resistance. All are proof-tested to military standards to 50% beyond safe working loads. Available in eye and shank styles in regular and safety patterns. Safety latches feature non- corrosive snap springs with positive, safety action. Alloy steel capacities up to 70 tons... carbon steel capacities up to 60 tons. Order from your Williams Distributor.

SIXTEEN STOCK SIZES CAPACITIES UP TO 70 TONS J. H. WILLIAMS & CO.

412 VULCAN ST., BUFFALO 7, N.Y.



For more data circle 432 on Postpaid Card

176

MODERN MACHINE SHOP

October, 1961

Projector

Opto-Metric Tools, Inc., 137 MM Varick St., New York 13, N. Y. Catalog 357 describes the floor Model A-F Wilder Micro-Projector with vertical light beam. For more data circle 46 on Postpaid Card

Drilling Machine

Avey Div., Motch & Merryweather Machinery Co., Box 1264, Cincinnati 1, Ohio. Bulletin 857 gives informative data on the MA-8 Drilling Machine.

For more data circle 47 on Postpaid Card

Contract Manufacturina

Lyon Metal Products, Inc., 113 Monroe Ave., Aurora, Ill. 20-page catalog en-titled "Craftsmen in Sheet Metal" tells a graphic story of what happens from the idea or blueprint stage to the finish-ed product. A complete listing of equipment from the coil steel lines to finishing and shipping is also included.

For more data circle 48 on Postpaid Card

Band Saw

Wells Mfg. Corp., 808 Tyler St., Three Rivers, Mich. Bulletin No. 230 describes the Wells Model 300 Metal Cutting Band

For more data circle 49 on Postpaid Card



For more data circle 434 on Postpaid Card







For more data circle 433 on Postpaid Card



MODERN MACHINE SHOP



Winter Brothers Acme Taps are the ideal tools for generating screw threads that transmit motion, particularly where heavy loads or precise positioning are important factors.

Famous Winter "Balanced Action" performance and superior quality are built-in features of every Acme Tap. Unequalled experience in all phases of tapping is your assurance that Winter will recommend the minimum number of Acme Taps to give you longer tool life and lower cost-per-hole. The result will be maximum economy on all of your Acme threading operations.

The skilled technical assistance of Winter Brothers engineering staff is available through your local distributor. Call him today.

Rochester, Michigan, U.S.A.

DISTRIBUTORS IN PRINCIPAL CITIES. BRANCHES IN NEW YORK CHICAGO . DALLAS . SAN FRANCISCO . LOS ANGELES



Choose from Winter's Wide Line of Taps, Dies and Gages

CALL YOUR WINTER DISTRIBUTOR

For more data circle 436 on Postpaid Card

free literature . . .

Cylinders

Hannifin Co., Dept. 166, 501 South Wolf Rd., Des Plaines, Ill. Bulletin 0220-B1, in color, illus-strates and describes Hannifin's 200 p.s.i. Series "C" Air Power Cylinders. Completely cataloged are both single and double rod end Series "C" model cylinders in five bore sizes ranging from 11/4 inches to 41/2 inches.

For more data circle 50 on Reader Service Card

Steel Equipment

Equipto Div., Aurora Equipment Co., 401 Highland Ave., Aurora, Ill. Reference Manual No. 488 covers book shelving, sorting files, many drawer cabinets and office storage units as well as slotted angle, mezzanines, shelving, lockers, work benches, carts, drawer units and a variety of other storage equipment.

For more data circle 51 on Reader Service Card

Metal Cutting Shears

Beverly Shear Mfg. Co., 3000 West 111th St., Chicago 55, Ill. Brochure, in color, describes different models of Beverly Metal Cutting Shears. Specifications are also included in the brochure.

For more data circle 52 on Reader Service Card

Abrasives

Weldon Roberts Rubber Co., 95 North 13th St., Newark 7, N. J. Catalogmanual covers methods and applications, machine speeds, job-matched stock items and complete range of wheel sizes.

For more data circle 53 on Reader Service Card

Wide Belt Finishing Studies

Carborundum Co., Niagara Falls, N. Y. Folder recites case study results where use of wide belts and wide belt machine for both wood and metal working cuts cost and at the same time expedites production while maintaining quality,

For more data circle 54 on Reader Service Card

Hydraulic Tracer

Detroit Broach & Ma-chine Co., 950 South Rochester Rd., Rochester, Mich. 2-page leaflet (DHT-161) describes features of a newly developed hydraulic tracer conversion unit. Conversion and operational advantages, illustrations and diagrams of typical machining applications and part configurations which may be handled are also included in the leaflet.

For more data circle 55 on Reader Service Card

Milling Cutters

Q-T Tool Co., 1000 R St., Bedford, Ind. Brochure, in color, describes Woodruff style cutters, side milling cutters and stagger tooth side mills. The brochure also explains about a 24 hour emergency service on any decimal width milling cutter within the standard size ranges of Deci-Mills

For more data circle 56 on Reader Service Card

Hydraulic Press Brakes

Dreis & Krump Mfg. Co., 7418 South Loomis Blvd... Chicago 36, Ill. Bulletin PHS (All) A-4 describes the Chicago Hydraulic Press Brakes, 100 to 2,000 tons capacity. Specifications and dimensions of the machines are also included in the bulletin.

For more data circle 57 on Reader Service Card





For every milling application, there's a job-proved National Cutter to give you more efficient operation and provide the tool life and production rate you require.

Your National Distributor, backed by the most competent engineering staff and the best testing facilities in the industry, has a truly complete line from which to select and recommend the right cutter for your specific needs.

All National Milling Cutters, both high speed steel and carbide tipped, are subject to highest quality control standards, from raw material selection to final inspection.

Whatever your particular milling problem, be sure to consult your National Distributor. You'll appreciate the many 'plus' values offered only by National.

ATIONAL TWIST DRILL & TOOL COMPANY

Rochester, Michigan, U.S.A.

DISTRIBUTORS IN PRINCIPAL CITIES. BRANCHES IN NEW YORK CHICAGO . DALLAS . SAN FRANCISCO . LOS ANGELES

*Just One of National's Parade of Plus Products



CALL YOUR NATIONAL DISTRIBUTOR

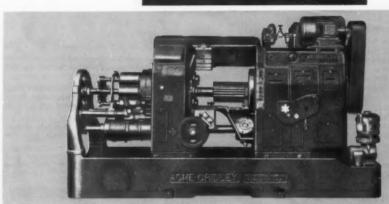
For more data circle 437 on Postpaid Card

ACME-GRIDLEYS CUT AVERAGE MAC

TIME 75% HELP HARDINGE BROTHING HOLD THE LINE ON END

"There's no question about it . . . Acme-Gridley Bar Automatics are one of the reasons we haven't raised prices of our precision machines and attachments since 1956! And here's why" explains H. A. Lundy, Vice President of Hardinge Brothers, Inc., Elmira, New York, "when we need over 250 identical precision parts that can be grouped with other parts made from the same size bar, the job automatically goes on an Acme-Gridley. By switching jobs like those shown from conventional turret lathes, we reduce machine time an average 75% including setup time. With this kind of efficiency, it is economical to stockpile parts far beyond our immediate requirements, and take advantage of lower part costs to hold the line on selling price."

As Mr. Lundy says . . . there's no question about it. For short as well as long runs of identical precision parts, Acme-Gridleys are a sure way to cut production costs and increase earnings for years to come. Get in touch. We'd be happy to provide complete details.



The Acme-Gridley 2" RB-6 Spindle Bar Automatic . . . produced all parts illustrated.



The number of different jobs that can be set up on any Acme-Gridley amazes everyone. To give you some idea, we've described some 57 actual jobs in a new 64-page bulletin called "Circumferential Automation at Work". For your free copy, call, write or wire.

HARDINGE PRODUCTION RECORDS ILLUSTRATE ACME-GRIDLEY SHORT RUN EFFICIENCY...

8620 Steel Clutch Cam. Run of 500 at 67 seconds per piece... 76.8% machine time reduction over previous method.

76.8% machine time reduction over previous method.

2 Rycase Steel Handle for Tailstock. Run of 850 at 59 seconds per piece...76.3% machine time reduction over previous method.

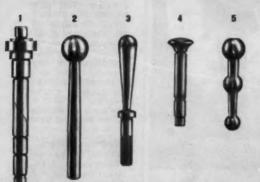
3 Rycase Steel Handle for Nut. Run of 1,100 at 61 seconds per piece...72.2% machine time reduction over previous method.

4 Rycase Steel Spindle Lock Pin. Run of 500 at 59 seconds per piece...76.3% machine time reduction over previous method.

5 C1117 (leaded) Steel Crank for Screw. Run of 2,000 at 44 seconds per piece...89.2% machine time reduction over previous method. (All machine time reductions include setup time.)



The Hardinge HLV-H Tool Room Lathe







National Acme

ales Offices: Newark 2, W.J.; Chicago 6, III.; Detroit 27, Mich.

The National Acme Company 183 E. 131st Street Cleveland B. Onio

For more data circle 438 on Postpaid Card

October, 1961

MODERN MACHINE SHOP

181

free literature . . .

Stock Reel and Bar Feeder Attachment

National Acme Co., 183 East 131st St., Cleveland 8, Ohio. Bulletin MFR-61 describes the combination magazine-fed stock reel and Acro bar feeder attachment for the Acme-Gridley Bar Machine. For more data circle 58 on Postpaid Card

Live Centers

Nielsen, Inc., Lawton, Mich. Catalog M gives information on Nielsen's Live Centers.

For more data circle 59 on Postpaid Card

Drill Pointer

Oliver Instrument Co., 1430 East Maumee St., Adrian, Mich. 12-page bulletin covers the Model 600 Drill Pointer. Technical information is provided on machines for wet and dry grinding as well as the automatic drill pointer with automatic infeed. The Model 21 bench drill pointer and drill point thinner is also described and illustrated in the bulletin. For more data circle 60 on Postpaid Card

Cartridges

Microbore Div., DeVlieg Machine Tool Co., Fair St., Royal Oak, Mich. Brochure MSD-101, in color, contains DeVlieg's

screw-on and clamp-on cartridges employed with throw-away precision carbide cutting tool inserts. Specifications are included on all standard cartridges available for both angular and straight mounting.

For more data circle 61 on Postpaid Card

Press Brakes

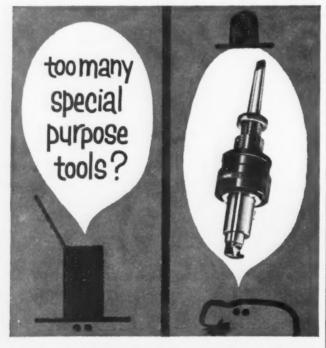
Verson Allsteel Press Co., 9300 South Kenwood Ave., Chicago 19, Ill. Catalog JI-61, in color, presents design details and specifications for Verson Junior and Intermediate size mechanical press brakes.

For more data circle 62 on Postpaid Card

Hardness Testers

Wilson Mechanical Instrument Div., American Chain & Cable Co., Inc., 230-G Park Ave., New York 17, N. Y. Catalog RT-58 gives complete information on the Tukon Tester as well as on the full line of Wilson Rockwell Hardness Testers.

For more data circle 63 on Postpaid Card



Scully-Jones automatic-feed recessing tools adapt standard drill presses and radial drills to a variety of intricate recessing jobs. "Building-block" design increases work range, reduces tooling cost. Feed is automatic and continuous. Choice of interchangeable stop collars and pilot nose assemblies to pilot either in fixture bushings or in work. For work hole diameters from 3/8" to 41/2"; depths of cut to .300".

Ask for Bulletin No. 10-50.

SCULLY

Scully-Jones and Company

1909 South Rockwell Street, Chicago 8, Illinois
For more data circle 439 on Postpaid Card

Chip Conveyor

May-Fran Mfg. Co., 1710 Clarkstone Rd., Cleveland 12, Ohio. Bulletin MF-650A, in color, illustrates and describes May-Fran's complete line of chip conveyors as standard accessories for use with modern high speed machine tools. Specifications are also included.

For more data circle 64 on Postpaid Card

Stainless Steel

Allen Mfg. Co., Hartford 1, Conn. Brochure (G22) compares stainless steel alloys according to advantages, limitations and applications. The brochure

lists chemical compositions and mechanical properties of 40 widely used stainless alloys, gives comparative corrosion resistance to various media, elevated temperature service data, and various other characteristics of stainless steel alloys.

For more data circle 65 on Postpaid Card

Diamond Wheels and Hones

Norton Company. Worcester 6, Mass. Catalog of diamond wheels and diamond hones contains general information on diamond wheels. recommended starting specifications for a wide variety of work, prices, and a section on wheels for silicon and germanium cutting operations.

For more data circle 66 on Postpaid Card

Hydraulic Press

Greenerd Arbor Press Co., 41 Crown St., Nashua, N. H. Catalog M-42 lists information on the Model No. B-2 Hydraulic Press.

For more data circle 67 on Postpaid Card **Gear Tooth Spacing Checker**

Michigan Tool Co., 7171 East McNichols Rd., Detroit 12, Mich. Data Sheet 1132 describes new checking system which simplifies analysis of gear and spline tooth-spacing errors.

For more data circle 68 on Postpaid Card

Clamps

Insta Clamp, 22504 Nona Ave., Dearborn 8, Mich. Bulletin 47-A describes Insta Hold-Down Clamps which holds work securely on jig borers, planers, punch presses, drill presses, mills and so on. For more data circle 69 on Postpaid Card



4501 ALPINE AVE., CINCINNATI 42, OHIO For more data circle 440 on Postpaid Card

free literature . . .

Machine Tools and Accessories

Walker-Turner Div., Rockwell Mfg. Co., Dept. 1016, 400 North Lexington Ave., Pittsburgh 8, Pa. 48-page catalog WT-60 Rev. 4. in color, describes a complete line of light-heavyweight machine tools and accessories which include drill presses, grinders, cut-off machines, band saws and belt and disc surfacers. Complete specifications, catalog listings and descriptions of accessories for all tools are also included.

For more data circle 70 on Postpaid Card

Lathe

Rivett Lathe & Grinder, Inc., 18 Riverview Rd., Brighton 35, Boston, Mass. Bulletin 1020 C1, in color, illustrates and describes the Rivett 1020 M Manufacturing Lathe. Variable power feeds and power tracer equipment featured on the lathe are also included.

For more data circle 71 on Postpaid Card

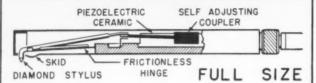
Ceramic Tooling

Vascoloy-Ramet Corp., 890 Market St., Waukegan, Ill. Bulletin 61-1 contains such items as where, when and how to use Ceramic VR-97, finishing informa-

tion, machinable, materials, tool geometry, new applications and ceramic troubleshooting. Bulletin 61-2 contains information on ceramic machining on hardened and heat-treated steels. Characteristics, recommended feeds and speeds, tooling tips and typical production operations are also included. Bulletin 61-3 describes the use of Ceramic VR-97 tooling on cast iron and other types of abrasive materials.

For more data circle 72 on Postpaid Card

SURFACE FINISH MEASUREMENT



PICKUP DESIGN

The heart of any surface finish measurement instrument is the pickup. This component determines the performance and versatility of the gage. The above design illustrates the most advanced pickup available. In many respects similar to a high fidelity phonograph cartridge, it employs a piezo-electric ceramic element, which is unaffected by temperature, humidity and other environmental factors. The flexing of this ceramic converts the variations in surface finish height into an electrical signal.

The self adjusting viscous coupling assures operation from a true neutral point and prevents excessive stylus pressure without critical leveling of the pickup. This feature also reduces the number of skids required. The inherent simplicity of the pickup design reduces maintenance as well as the initial cost of the equipment. The small size of the basic pickup eliminates the need for many special types or adapters. Other pickups are available which permit measurements on very small or narrow areas, flanges, thread flanks, gear teeth, small internal diameters and "O" ring grooves.

All other Roughness Meter items, amplifier, mechanical trace and skidless trace, make use of similar advanced designs.

Write for information or a demonstration.

Cleveland INSTRUMENT COMPANY A SUBSIDIARY OF THE BENDIX CORPORATION

6220 East Schaaf Road . Cleveland 31, Ohio

For more data circle 441 on Postpaid Card

Boring Machine

Olofsson Corp., Lansing, Mich. Catalog Sheet No. B-1 describes the Model 21 single end precision boring machine. Design features, exclusive to this particular model, complete specifications and a specification diagram which shows side. end, and top views of the machine and includes all pertinent dimensions are also included. For more data circle 73 on Postpaid Card

Vises and Rotary Tables

Palmgren Products, 3899 South Chicago Ave., Chicago 17, Ill. Catalog No. 208, completely illustrates, gives information on vises and rotary tables for production, tooling and maintenance now. The literature includes 70 different models and types.

For more data circle 74 on Postpaid Card

Cutting Tools

Eclipse Counterbore Co., 1600 Bonner Ave., Detroit 20, Mich. Catalog C59 contains information on H.S.S. cutters, T.C.T. cutters, core drills, back spotfacers, multi-diameter cutters, inserted blade cutters and port contour cutters. For more data circle 75 on Postpaid Card

Dry-Film Lubricants

Alpha-Molykote Corp., 65 Harvard Ave., Stamford, Conn. Special Print No. 461, a four-page reprint from the "Journal of Chemical & Engineering Data," describes the results of tests of inorganic, solid-film lubricant performance in liquid oxygen service and at pressures approaching complete vacuum. A second publication, Products Information Bulletin No. 242, presents characteristics, performance reports and application instructions for Molykote X-15, an inorganic-bonded dry film lubricant specially formulated for extreme environmental service

Miniature Power Tools

Foredom Electric Co., Inc., Bethel, Conn. Catalog 210A, in color, illustrates and describes miniature power tools and handpieces. Four basic miniature power tools as well as large selection of miniature handpieces for grinding, deburring, drilling, sanding, polishing, cutting and so on, are described. For more data circle 77 on Postpaid Card

For more data circle 76 on Postpaid Card

End Mills

Weldon Tool Co., 3000 Woodhill Rd., Cleveland 4, Ohio. Bulletin SKX-10 describes the Series SKX End Mills especially designed for profile finishing of aluminum and most non-ferrous metals.

For more data circle 78 on Postpaid Card

Production and Inspection Equipment

Taft-Peirce, 9 Mechanic Ave., Woon-socket, R. I. Catalog No. 511 lists over fifty different types of production and inspection tools to make it easier to produce and to simplify setups and

For more data circle 79 on Postpaid Card

THE ORIGINAL

BROWN BLOCK CHUCKS

Simplify Accurate 60° - 90° 120° - 180°

Indexing



"Hardened and ground within .0005 Save tooling costs on short runs!

less SQUARE collet \$44.00

HEX collet \$46.50

Also available for use with Brown Block Chucks: Collets, Collet Closers, Collet Stops, Spanner Wrenches. RODUCTS.INC. Box 1057, Danbury, Conn.

For more data circle 442 on Postpaid Card



a complete

COOLANT with . . . No Oil, No Phosporous, No Sulphur, No Chlorine Vytron's proven performance in metal cutting and grinding assures:

NO RANCIDITY

HIGHER SPEEDS

LONGER TOOL LIFE

RUST PROTECTION

Mist or Flood All Metals except Magnesium

DYNAMIC CHEMICAL Co., Inc. 261 Main Street, Danbury, Conn.

For more data circle 443 on Postpaid Card

MODERN MACHINE SHOP

185

free literature . . .

Drill Sets

Ace Drill Corp., Adrian, Mich. Folder covers Ace High Speed Steel Drill Sets for general purpose industrial applications. Also included are brief descriptions of ten convenient drill sets ranging from the pack of 5 triple-duty ¼ inch shank drills to the Ace "Wirepak" set of 60 drills in wire gauge sizes from 1 through 60.

For more data circle 80 on Postpaid Card

Band Saw

Johnson Mfg. Corp., 1011 Barnes St., Albion, Mich. Catalog describes and illustrates in full all models of Johnson Band Saws and accessories.

For more data circle 81 on Postpaid Card

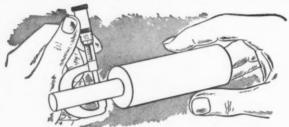
Gages

Boice Gages, Inc., Hyde Park, N. Y. 8-page, 2-color, catalog 1-A describes and illustrates five complete Reliant Gage Sets, for a total range of bore diameters from 0.157 inch to 4.883 inch, to-

gether with individual gage models for single range applications. Also included are three gage sets for snapring grooves, for bore diameters from 0.240 inch to 5.470 inch, together with the individual models for limited range applications.

For more data circle 82 on Postpaid Card

For More Accurate Machining



USE FISKE'S DARL BASE OIL

FISKE'S DARL BASE OIL can be used straight or reduced with mineral oil to exactly suit the work, the tool and the metal. Non-corrosive, works both ferrous and non-ferrous metals. Does not hide the work. Has excellent anti-weld value, lubricity and film strength. An exceptionally effective oil for drawing and stamping, as well as for machining.

SEND FOR DESCRIPTIVE BULLETIN. WRITE TODAY.



METAL WORKING LUBRICANTS

FISKE BROTHERS REFINING CO.

129B Lockwood Street, Newark 5, N. J. Plants: Newark 5, N. J. Toledo 5, Ohio For more data circle 444 on Postpaid Card

Digital Process Controllers

Louis Allis Co.,
Dept. P, 427 East
Stewart St., Milwaukee 1, Wis.
Bulletin No. 201-A
illustrates and describes digital
process controllers
for counting,
measuring, indicating and control
applications.
For more data circle
83 on Postpaid Card

Fire Safety

Equipment
Walter Kidde &
Co., Inc., 675 Main
St., Belleville 9, N.
J. Brochure P-67
illustrates and describes full line of
Kidde Portable
Fire Extinguish
ers, Smoke and
Fire Detectors,
and Built-In Type
Carbon Dioxide
Systems.

For more data circle 84 on Postpaid Card

Dust Collectors

Torit Mfg. Co., Dept. 729, 1133 Rankin St., St. Paul 16, Minn. Handbook details specifications and performance data on Torit Dust Collectors and applications. For more data circle 85 on Postpaid Card

Cylinders

Sheffer Corp., 326 West Wyoming Ave., Cincinnati 15, Ohio. Bulletin No. 861, in color, describes an improved new "CLA Series" 1½ inch clamp type 150 p.s.i. air cylinder and 250 p.s.i. hydraulic cylinder with universal, clevis, pivot or stud

mountings, plus an improved extra compact "Val-N-Head" solenoid operated cylinder. For more data circle 36 on Postpaid Card

Reamers

Precision Twist Drill & Machine Co., 13 Woodstock St., Crystal Lake, Ill. Bulletin No. 761 gives information on a wide range of precision reamers which includes chucking, taper pin, Morse and center. Valuable tips and rules for obtaining maximum efficiency and life from reamers are included.

For more data circle 87 on Postpaid Card

Form Relieving

R-O Mfg. Co., 31171 Stephenson Highway, Madison Heights, Mich. Catalog, in color, illustrates and describes equipment and methods for performing form relief grinding on a variety of cutting tools. Complete descriptions of all accessories are also included. For more data circle 88 on Postpaid Card **Tap Drivers**

Scully-Jones and Company, 1909 South Rockwell St., Chicago 8, Ill. Bulletin No. 20-50 describes three types of tap drivers.

For more data circle 89 on Postpaid Card

Abrasives

Cratex Mfg. Co., Inc., 1600 Rollins Rd., Burlingame, Calif. 22-page Cratex Application Manual, including a complete illustrated catalog, gives information on Cratex Rubberized Abrasives.

For more data circle 90 on Postpaid Card



BOTH VISES FOR DRILLING • GRINDING BORING . . . JIGS AND FIXTURES

(locking pressure of 2 tons or better)

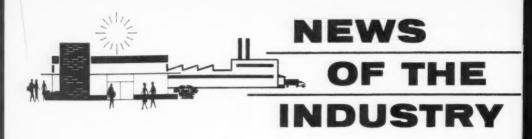
All-purpose tool room and machine shop vise. Quickly adjustable to various sizes of work.

WRITE FOR LITERATURE TODAY!

Harig Manufacturing Corp.

5765 W. HOWARD STREET . CHICAGO 48, ILLINOIS

For more data circle 445 on Postpaid Card

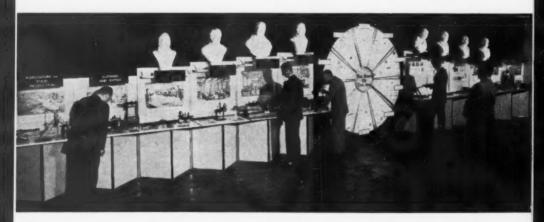


DoALL TRAVELING EDUCATIONAL SHOW

Major events that began with the Industrial Revolution and brought man to his present state of material welfare have been compressed into a 46½ foot long traveling educational exhibit that began a three-year tour of the country. It will be shown before engineering societies, civic, management and educational groups. The exhibit is the fourth of its type created within the past decade by The DoAll Company, Des Plaines, Ill., a producer of machine tools, cutting tools and precision measuring instruments. Called "The Story of Productivity," the display is built around a

"sunburst" 8 feet in diameter that records in 10 classifications 157 major events that ushered in man's age of abundance.

A lecture describing and coordinating the events in the "sunburst" to point up how the foundation was laid for today's era of high productivity comprises the first half of the presentation. Flanking the "sunburst" on each side are 6 display panels and tables, and above 8 of these are lifesize busts of great innovators. The tables contain originals, exact replicas or models of inventions that made major contributions toward man's progress. They include an 18th-century French clock and the machines used to produce its parts, Arkwright's



View shows DoAll traveling educational exhibit entitled "The Story of Productivity"

"spinning jenny," a working model of Watt's first steam engine, Morse's telegraph, Bell's telephone, McCormick's reaper, and many other significant inventions.

The second part of "The Story of Productivity" consists of color slides that examine the strides made in various areas of human progress since 1900. They are shown on a wide-angle screen that lowers in front of the

"sunburst." An accompanying lecture reviews the role various groups of society can play to accelerate the nation's economic growth. Following the slide presentation the audience is invited to inspect the main display and an additional 4 tables with illuminated back panels that show modern production and quality control methods.

* mms

DIRECTOR ELECTED

Firth Sterling Inc., Pittsburgh 30, Pa., has announced the election of Joseph C. Abeles, president, Kawecki Chemical Company, Boyertown, Pa., to the board of directors of the company. Mr. Abeles succeeds Dr. Paul F. Gen-

achte, now vice president, International Department, The Chase Manhattan Bank, New York, N. Y.

* modern machine shop *

LEES-BRADNER LICENSES FIRM TO SELL GEAR HOBBERS

The Lees-Bradner Company, Cleveland, Ohio manufacturer of gear hobbing machines and thread milling ma-



Elasticones are metal-formed, cone shaped covers that open and close automatically to provide protection against dirt, damage, and catching of limbs, for all precision moving parts. Available in all finishes and sizes from %" diameter up to 60" long.

Stocking distributors in principal cities

ELASTICONE DIVISION

CENTRAL SAFETY EQUIPMENT CO.

6606 Marsden St., Philadelphia 35, Pa. • DEvenshire 3-4788
For more data circle 446 on Postpaid Card

news of the industry . . .

chines, has licensed Precision Gear Machines & Tools, Ltd., Coventry, England to manufacture and sell the Type 7-HD, single-spindle, Lees-Bradner Gear Hobbing Machine in the United Kingdom. The Type 7-HD gear hobber is a single-spindle, high production gear hobbing machine designed for maximum rigidity, simple setup and for ease of adjustment.

MIMIK EXPANDS PLANT

A major plant expansion program for Mimik Tracers Inc., Buffalo, N. Y., due for completion this year, has been started. The first phase calls for an 11.500 square foot research and development facility in Galt. Ontario. where, in addition to basic research. advanced production techniques, using the Mimik Tracer, will be developed.

This will serve the two-fold purpose of stepping up production to meet

> rapidly increasing demand, and demonstrating to prospective customers the versatility and effectiveness of the Mimik in a major cost reduction program.

m m s

AMERICAN **TOOL WORKS** MANAGER

Alvin C. Appel, formerly plant engineer, has been appointed works manager at The American Tool Works Company, Pearl Street at Eggleston Avenue. Cincinnati, Ohio.



Alvin C. Appel



ciple, time is cut to a fraction of the single tooth method. Adjustments are

held to a minimum and cutting speed is always maximum, regardless of size or length of cut, or the material

being worked. Simple to use even for an unskilled operator. Many of our

original models are still giving efficient service after years of use. Tell us your problem. We'll be glad to

Division of Hansford Manufacturing Corporation 3116-A Winton Road South, Rochester 23. New York

help solve it.

For more data circle 447 on Postpaid Card

TODAY

for

FREE

Literature

Mr. Appel received his M.E. degree at the University of Cincinnati in 1949. He joined American Tool Works as plant engineer in March, 1960 and will now be in charge of all manufacturing operations.

* modern machine shop *

EUTECTIC SPONSORS NATIONAL AND REGIONAL WELDERS' CLUB

Organization of the National Eutectic Maintenance Welders' Club and

sponsorship of Regional Eutectic Maintenance Welders' Clubs has been announced by the **Eutectic Welding** Alloys Corporation, manufacturer of welding electrodes, rods and chemical aids. Flushing. N. Y. is its headquarters for a world wide organization.

Eutectic's chairman of the board, Rene D. Wasserman, is the founder of the new organization. Mr. Wasserman discerned the need for a membership activity which would serve the welder and those concerned with welding in a practical nontechnical way. Professional technical societies provide excellent engineering and

metallurgical services and education through regional meetings and publications. However, practical welders, particularly those in the maintenance field, have additional and specialized needs which can be satisfied only through activities permitting talks in non-technical language on new techniques and materials, on-the-spot demonstrations, audience participation through try-it-yourself facilities, and opportunities to exchange information with other welders; all in regularly



SO EASY TO USE IN SO MANY WAYS

Lyon Slotted Angle is the low-cost answer for bulk storing and stacking.

Write for free 100-page Lyon catalog

LYON METAL PRODUCTS, INC.

General Offices: 113 Monroe Ave., Aurora, Illinois Factories in Aurora, III.—York, Pa.—Los Angeles Dealers and Branches in All Principal Cities

For more data circle 448 on Postpaid Card

news of the industry . . .

scheduled get-togethers. Within this area Mr. Wasserman and Mr. Leonard C. Barr, Eutectic's president, believe that its company's institution of Welders' Clubs can render a distinctive and valuable service to welders and industry concerned with the joining of metals.

* modern machine shop *

HARIG TO OPEN TOOL AND DIE PLANT IN INDIA

Final approval by the government of India has been given to a joint venture of the Harig Mfg. Corp., Chicago, Illinois, and Mr. K. S. Malik of New Delhi, India, to set up a tool and die shop in that city. Total investment in the project will run \$200,000 with Harig retaining a 50 percent interest.

For its part, Harig is supplying the

equipment and know-how to produce not only tools and dies, but other Harig products such as: Surface Grinders; Grind-All Fixtures (precision perforator grinders); Rapidset Drill Press Vises (fast-action vises for machine shop and production use); Relief-Grinding Fixtures (drill point sharpeners) and Air-Flo End Mill Grinding Fixtures.

* modern machine shop *

RACINE HYDRAULICS ACQUIRES INTEREST IN GETTYS

Racine Hydraulics & Machinery, Inc., Racine, Wis., a leading U. S. producer of hydraulic components for industrial uses, has acquired a one-third interest in Gettys Manufacturing Co., Racine specialist in electronic and electro-mechanical systems. Gettys Manufacturing will share responsibility in the designing, installation



DURANT TOOL COMPANY

17 THURBERS AVENUE, PROVIDENCE 5, RHODE ISLAND

For more data circle 449 on Postpaid Card

and servicing of complete electrohydraulic systems for the firm.

The collaboration with Gettys Manufacturing is expected to figure very importantly in production of special hydraulic drives in the 10 to 1000 horsepower range and anticipate that it will be a stimulant to the growth of both our domestic and foreign hydraulic business. Packaged elec-

tronic systems of the type Gettys will develop for Racine equipment are applicable in the machine tool industry, heating, ventilating and air conditioning equipment, printing presses and heavy milling equipment, and so on. Its principal advantage is said to lie in the superior capabilities of electronic control coupled with the high reliability of transistors.

One of these Wilson "Rockwell" instruments will do your hardness testing job

No matter what your hardness testing requirements are, there's a Wilson "Rockwell" tester to do the job. Choose from this complete selection of hardness testing equipment:

"Rockwell" Hardness Tester—for most hardness testing functions.

"Rockwell" Superficial Tester—for extremely shallow indentations.

TwinTester—Combines functions of "Rockwell" and "Rockwell" Superficial testers.

Semi and Fully Automatic—for high-speed testing, at rates up to 1,000 pieces per hour. Automatically classifies pieces as CORRECT, TOO HARD, or TOO SOFT.

Special Machines—for testing large objects, internal readings, and other unusual applications.

Diamond "Brale" Penetrators—Flawless diamonds, individually calibrated, and highest quality construction assure perfect testing every time.



Write for Bulletin RT-60

WILSON "ROCKWELL" HARDNESS TESTERS

See us in Booth 952 National Metal Show Detroit

Wilson Mechanical Instrument Division American Chain & Cable Company, Inc.

230-G Park Avenue, New York 17, New York For more data circle 450 on Postpaid Card



NEW EQUIPMENT

BORING, MILLING AND DRILLING MACHINE

A 3 inch horizontal boring, milling and drilling machine with 40 foot bed and 20 foot table has been introduced by S & S Machinery Co., 140 53rd St., Brooklyn 32, N. Y. One model consists of a 3 inch horizontal boring, milling and drilling headstock and column with pendant controls to operate feed and rapid traverse to the headstock. The 40 foot bed and 20 foot table, with separate drive, operates through elec-

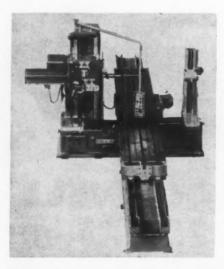
tronic thyratron and pendant controls. Optional accessories are also offered such as a facing head on swivel gib, vertical milling head, universal milling head, optics reading to 0.0001 inch for full length of table, airflow equipment, rotary table and so on. Building block design provides variations in table and bed lengths and column height. The 20 foot table rides on special edge grained plastic inserts to reduce friction and is operated by separate thyratron controls.

For more data circle 91 on Postpaid Card

* modern machine shop *

ABRASIVE BELT GRINDERS BUILT IN TANDEM

Two operations are performed in one pass by two Tri-Matic Oscillating Abrasive Belt Grinders built in tandem by Sales Service Mfg. Co., 2361 University Ave., St. Paul 14A, Minn., to rough and finish grind parts. The two 18-inch machines have been adapted to tandem operation with a minimum of special engineering. The controls for each workhead are mounted individually on each machine to provide maximum flexibility of variables such as abrasive belt tension, speed, and so on. This is said to make it possible to obtain the best results on two different operations at one pass. Separate conveyors were used on this machine to avoid grinding dust and dirt from being carried over from the



View of S & S Supermill AL76 Horizontal Boring, Milling and Drilling Machine

and

MATERIALS

rough to the finish operation. Where this is not a factor a single conveyor belt and drive may be used.

The Tri-Matic workheads have the standard features of controlled abrasive belt oscillation; separate wheels for abrasive belt driving, steering and work contact; the elimination of belt steering problems through the controlled oscillation; rapid belt changing made possible by the elimination of belt guides or other projections to interfere with removing or installing belts. The ease of belt changing makes it a very simple task to change grind-

ing set-ups according to the company.

Work pressure is controlled by adjusting the knee on which the conveyor is mounted. The workhead is rigidly mounted on a rugged column and the entire machine is claimed to provide a high degree of precision. Any number of units can be arranged in tandem to accomplish a series of operations. For more data circle 92 on Postpaid Card

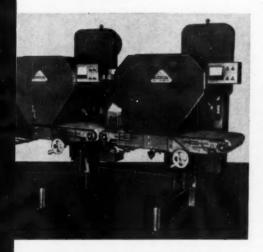
★ modern machine shop ★

SOLID-STATE COMPUTER CONTROL FOR MACHINE TOOLS

High speed computer techniques for automating production machinery became available to small and medium sized metalworking concerns with the announcement of a low-cost programming system for controlling automatic machine tools, states its developers, Remington Rand Univac, 315 Park Ave., South, New York 10, N. Y., and Rohr Aircraft Corp., Chula Vista, California.

The programming system for the Univac Solid-State 80 and 90 computers simplifies compiling of the complex instructions needed to guide numerically-controlled tools in the machining of parts. A feature of the system is its ability to guide the machine tool control devices of many different manufacturers. The system will be available at all Univac Service Centers.

Among the machines being guided

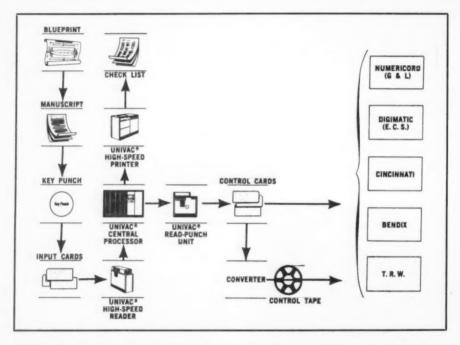


View of Sales Service Two 18 Inch Tri-Matic Oscillating Belt Grinders built in tandem for rough and finish grinding in one pass.

automatically by computer-generated instructions at Rohr are a Giddings and Lewis Profiler, Morey Vertical Profilers, Cincinnati Skin Mills and a Cincinnati Traveling Column.

The Univac program uses a part programmers manuscript, a simple statement of manufacturing information prepared from an engineering drawing of the part, Cards are punched from this manuscript and fed into the computer where they are interpreted. Punched cards used to control the machine tools are then produced automatically by the computer. For machine tools which cannot accommodate a control card input, appropriate conversion to a control tape is made.

These machines are used to shape a multitude of different aircraft parts including blowout doors, longerons, midspar fittings and firewall frames. Univac plans to make these numerical



First step in the preparation of numericallycontrolled machine tool instructions by Univac Solid-State computer is the transposition of engineering drawing information to a manuscript. Manuscript contains basic information relating to part geometry, feed rates, spindle speeds and auxiliary instructions for the machine tool. This information is transferred to punched cards which are read by the High-Speed Reader and transmitted to the Central Processor. Here, the data is interpreted and processed according to the internally stored program. Results are translated into numerical control codes and are, at the same time, printed on the Univac High-Speed Printer, which produces an easy to read listing of the machine tool instructions. This facilitates a visual check of the part program. Cards containing these codes are also punched on Read-Punch Unit. These cards contain all the control data necessary to guide tool through complete manufacture of a part.



Dr. Gastone Chingari (left), director of numerical control applications for Remington Rand Univac, and Nils Olesten, numerical control general supervisor for Rohr Aircraft Corp., check over program data used in automatic production of complex hinge fitting for aircraft on a numerically controlled machine tool. Behind them is the Univac Solid-State computer which generated instructions used to guide machine tool in shaping the part. Rohr has reported manufacturing savings ranging up to 66 percent through the use of the medium-scale Univac computer for generation of numerical control instructions.

control programming routines available without cost to those industrial users employing the division's Solid-State computers.

For more data circle 93 on Postpaid Card

modern machine shop *

CHAMBER FOR ENVIRONMENTAL TESTING

Cincinnati Sub-Zero Products, 3930 Reading Rd., Dept. S-1, Cincinnati 29, Ohio, has introduced a sixty-four cubic foot environmental test chamber. Model HASU-100-64-HC combines Hi-Lo temperatures, altitude and humidity into compact assembly. Environmental extremes in the sixty-four foot stainless steel chamber, 48 inches high by 48 inches wide by 48 inches deep are accomplished as follows: low



Model HASU-100-64-HC Test Chamber

to minus 100 degrees F. in 2½ hours; high to plus 200 degrees F. in one hour; sea level to 100,000 feet altitude in thirty minutes; and humidity, 20 to 95 percent with a dewpoint limitation of 35 degrees F. Accuracy of control is by means of two-pen, two-cam, wet and dry bulb controllers with 12 inch circular charts.

The chamber, with 22½ by 39½ inch multipane, frost free window, is equipped with terminals and ports; and a minimum temperature stratification results from the use of air circulation. The cabinet which measures 90 high by 60 wide by 84 inches deep is heavily insulated, and especially finished to prevent moisture accumulation. The unit operates on 440-60-3, with 110-volt controls.

For more data circle 94 on Postpaid Card

★ modern machine shop ★

MULTIPLE HEAD GRINDING AND POLISHING MACHINE

Hill Div., Hill Acme Co., 1201 West 65th St., Cleveland 2, Ohio, has introduced a four-head grinding and pol-

ishing machine for the progressive finishing of stainless steel coiled strip which is said to process material 0.010 inch to 0.250 inch thick and 50 inches wide. The entire unit requires less floor space and the flexible design permits the addition of any number of additional grinding heads.

Each grinding head is composed of an endless abrasive belt running over a two-roll head with a motorized adjustable steel billy roll for increasing the belt pressure against the steel strip. The belt on any head can be changed while the others are in operation. Rubber covered guide rolls, built into the machine, create the proper "break" angle of the strip over each billy roll to flatten the strip at the point of contact with the abrasive

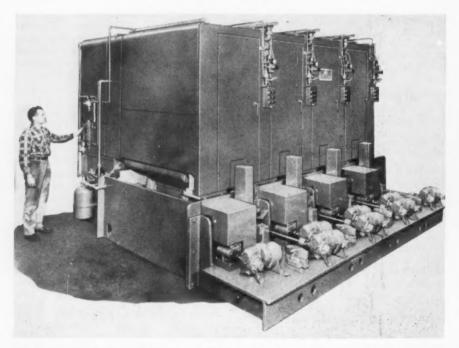
For heavy stock removal "wet" grinding is recommended with 600 g.p.m. coolant. Sludge passes through the bottom of the machine to the filter units. A built-in oil mist spray system is used in finishing operations. The unit is equally efficient for either "wet" or "dry" operation.

For more data circle 95 on Postpaid Card

* modern machine shop *

ACTUATOR

The Electro-Mechano Co., 265 East Erie St., Milwaukeee 2, Wis., has introduced an air-hydraulic unit which is said to overcome the compressibility of air power to provide smooth work or tool feeding. As a result, tool life and production are increased, rejec-



Hill Acme Multiple Head Grinding and Polishing Machine for "wet" or "dry" operations

Both NEW and DIFFERENT SHELDON 15" PRECISION LATHES



NEW

New. Revolutionary double-box Headstock (Pat. Pend.)

New. "WORK-HOLDING ONLY"
Spindle.

New. Single-Shift Back Gear Lever on Headstock.

New. Headstock and Apron running in oil.

New. 1/1" Hole through Spindle. New. 60-pitch Gear Box with built-in Lead Screw Reverse. New. Amazing LOW PRICE.

DIFFERENT

Different. Spindle rigidly held in two large "Zero Precision tapered roller bearings arranged in box-type design.

Different. Electrical switches and push-button stations fully enclosed in built-in well in head-

Different. Two independent clutches in apron for selecting power feeds.

Different. Cam-action tailstock clamp for rapid release and instant locking of tailstock.

Different. Triple, cogged, V-belt outboard drive—eliminates intermediate shafts—delivers more power to spindle.

This is an all new lathe that bridges the gap between conventional belt driven and geared head lathes. It combines the capacity and power of a geared head with the economy and flexibility of a belt driven lathe. Available with 5', 6' and 8' bed lengths providing 31", 42" and 66" center distances.

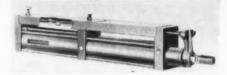
	HELDON MACHINE CO.		Ave., Chicago	41, U.S.A.
Gentlemen: Please send me information on items checked. The NEW and DIFERENT SHELDON 15" Lathes Sheldon 10" 11" 13" Lathes				
	11" and 13" Variable Speed Lathes High Speed Turret Lathes Sebastian 13" and 15" Geared Head	Name	Title	
	Lathes Herizontal Milling Machine Sheldon 12" Shaper	Street Address		☐ Company
	Name of Local Dealer Have Representative Call	CityState		

For more data circle 451 on Postpaid Card

Send in Coupon

for full information

tions lowered and operator fatigue reduced. Two easy-to-reach movable cams make it possible to set up any combination of fast, slow and skip feed strokes. A built-in bypass valve with traveling rods allows rapid advance to any point in the stroke, controlled rate of feed for any distance, pick-up to rapid feed and return to controlled rate. This cycle can be



Electro-Mechano Air-Hydraulic Actuator

repeated several times during the stroke by merely setting the bypass valve cams.

The front portion of the air-hydrau-

lic unit is an air cylinder connected to the shop air line. This provides the moving force. The rear section of the unit is a hydraulic control cylinder which works by metering the flow of oil from one side of the piston to the other. A simple needle valve adjusts this flow. For rapid advance and feed a specially designed valve opens a wide passage around the needle valve to allow full flow of oil. This operation is controlled by adjustable cams on the traveling rods attached to the piston shaft. A transparent oil reservoir is an integral part of the unit and insures a constant check on the oil supply. The controlled feed is

LOCTITE Sealant

Locks stripper bolts tight against vibration



Loctite, a penetrating liquid resin that hardens automatically when confined between closely fitted metal parts, *locks* threads of cap and shoulder screws in place . . . holds them *secure* against all shock and vibration in your press tools. And parts treated with Loctite can be removed with ordinary tools.

Call your distributor, or write for literature and free sample.

LOCTITE SEALANT

AMERICAN SEALANTS COMPANY
225 North Mountain Road, Hartford 11, Connecticut

For more data circle 452 on Postpaid Card

on any tapping job . .

MORE PRODUCTION PER

HOUR means LOWER COST

for YOU with a

Kaufman MODEL 10E-20 TAPPING MACHINE

More and more manufacturers are learning this fact from hour after hour, day after day, precision production tapping on the Kaufman 10E-20. With higher production, lower product cost, increased sales in mind—you, too, should learn all about the Kaufman 10E-20.





Write, wire or phone for complete information on the precision tapping machine — the Kaufman 10E-20.

kaufman MFG.

PRECISION MACHINES FOR TOP PRODUCTION

551 S. 29th St., Manitowoc, Wisconsin

For more data circle 453 on Postpaid Card

during the outward stroke. The inward stroke has continuous fast feed for rapid retraction.

Made in sizes 2 and 3 inch bores, the Electro-Mechano Air-Hydraulic Unit is available in 2, 4, 6 and 8 inch stroke lengths. The 2 inch bore gives a thrust approximately three times the air line pressure. The 3 inch bore gives a thrust seven times air line pressure. The hydraulic control sec-

tion of the Electro-Mechano Air-Hydraulic Unit is available separately. This compact, self-contained package can be used to give smooth, hydraulic movement to many manual or mechanical operations.

For more data circle 96 on Postpaid Card

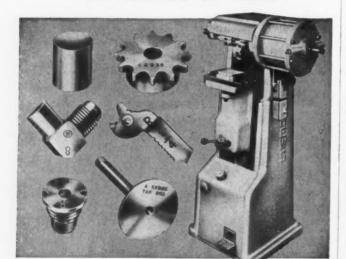
* modern machine shop *

HAND GRINDER

Dremel Mfg. Co., 2420 18th St., Racine, Wis., has announced the pro-

duction of an industrially rated hand grinder. Called the Model No. 3, the unit is said to have a 50 percent increase in power and efficiency over the earlier Model No. 2 and runs much

The unit develops 27,000 r.p. m. and sustains its high torque under load. It was designed to cover a wide range of industrial applications including polishing and grinding dies and molds. model



VERSATILE MARKER

for rounds or flats

If you have a variety of shapes to mark, write for Bulletin FGP 20. Full description of Matthews General Purpose Machines.



JAS. H. MATTHEWS & CO. 3962 Forbes Ave. • Pittsburgh 13, Pa.

For more data circle 454 on Postpaid Card



Model No. 3 Industrial Hand Grinder

shop work, production deburring, and general tool and die room use.

The motor is housed in shockproof Bakelite and is equipped with a 3 wire ground cord for maximum safety. With a collet capacity of 1/16, 3/32, and 1/8 inch, it accommodates all standard wheels and burrs. Its lightweight of only 18 oz. gives the operator highly sensitive control on close tolerance work. Its lightweight and ease of handling is particularly desirable where women operators are involved. For more data circle 97 on Postpaid Card

modern machine shop *

SHEET SUPPORT FOR POWER SQUARING SHEARS

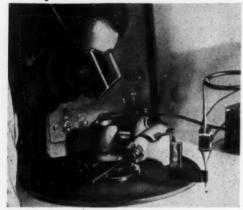
Accurate gaging of wide, thin, flexible sheets on Niagara Power Squaring Shears is said to be assured by a magnetic sheet support introduced by Niagara Machine & Tool Works.



View shows Niagara Magnetic Sheet Support

Buffalo, N. Y. Designed for use with ferrous materials 16 gauge and lighter, the support consists of several sets of magnetized rollers attached to the crosshead of the squaring shear. These rollers grip the material and hold it level to prevent drooping as the sheet

People work better when they SEE BETTER®



Lockheed Aircraft Corp., Missile Systems Div., uses MAGNI-FOCUSER to watch Ultrasonic Drill making holes five thousands of an inch, the size of human hair.

MAGNI-FOCUSER

For increased production, greater accuracy, fewer accidents and errors, use the MAGNI-FOCUSER-the new 3-D binocular magnifier with matched prismatic lenses. It provides needlesharp vision - greatly magnified and in third dimension.

Scores of industrial jobs are being aided by the MAGNI-FOCUSER. It reduces eve strain and avoids squinting: leaves both hands free to work. It's light weight; can be worn with or without eye glasses; normal vision resumed simply by raising the head.

Speed your production by ordering now on 10-day trial basis without obligation. Only \$12.50. Immediate delivery. Or write for illustrated folder.

the 3-D Magnifier that speeds production and leaves both hands free to work

EDROY PRODUCTS CO., Dept. P, 480 Lexington Ave., New York 17, N. Y.

For more data circle 455 on Postpaid Card

passes from the rear of the bed to the back gage. Holding power of the magnetized rollers is just enough to support the sheet until it is cut. Then the severed portion falls free instantly. For more data circle 98 on Postpaid Card

* modern machine shop *

CUT-OFF MACHINE

Model 102-A, an abrasive cutting machine has been announced by Allison-Campbell Div., American Chain & Cable Co., Inc., 931 Connecticut Ave., Bridgeport, Conn. Designed to provide the advantages of abrasive cutting at a relatively low investment, the Model 102-A cuts solids up to 4 inches square, pipe and tubing up to 65% inches o.d., angle iron up to 6 by 6 inches, channels up to 8 inches and flat stock up to 6 inches by 1 inch. It is versatile,



Model 102-A Abrasive Cut-Off Machine

as a simple vise type clamp firmly holds a variety of shapes. It cuts most metals at a rate of 3 to 4 seconds per

New standard for power and torque in a compact grinder!

NEW Dremel No. 3 Industrial Moto-Tool

Breakthrough in small grinder design! New, powerful Dremel No. 3 operates at 27,000 rpm — and sustains high torque under load. And it weighs only 17 oz.! Its compact size, non-tiring, cool-running operation makes it ideal for industrial applications — grinding and polishing of dies and molds, production deburring, patternmaking, general tool room use. 110 V AC or DC motor has heavy-duty, shockproof case. No. 3 Moto-Tool complete with 1/8" and 3/32" collets, 3-wire grounding cord and 2-prong adapter, finger grip, in steel storage case . . . \$29.95.

Order From Your Supplier or Write for Industrial Bulletin

DREMEL MFG. CO., Dept. 221-J, Racine, Wisconsin

For more data circle 456 on Postpaid Card



October, 1961

square inch. For example, a 4 inch square bar of steel can be severed in less than a minute.

Excellent quality of cuts are said to be obtained due to the Campbell oscillating feature, easily adjustable carbide tipped wheel guides, and superior coolant distribution. The oscillating action permits cutting large cross sections, assures more cuts per wheel, gives better quality cuts, re-

quires less cutting pressure and reduces operator fatigue. Safety features include a stationary wheel guard which gives complete operator protection and fiber glass reinforced plastic curtains to prevent coolant splash. Push button station is at chest level with single "off" button and for convenience the operating handle is adjustable. A large separate coolant tank is furnished with the machine and is mounted on casters to permit easy removal for cleaning. Separate compartments settle out sludge and keep coolant clean. The coolant is conveyed to coolant distributor inside the wheel guard through a hose. A variety of work

holders and work support stands are available as optional equipment which contribute to the versatility of the Model 102-A.

For more data circle 99 on Postpaid Card

★ modern machine shop ★

END MILLS

Quality Tool Works, 330 S. Elmwood Ave., Waukegan, Ill., has announced the addition of a complete



line of HSS end mills to its present line of arbor and shank style HSS milling cutters. The tools are marketed under the trade name "Gold Label End Mills" and are readily identified by the metallic gold lacquer imprint on the set screw flats. The end mills are standard in sizes ranging from 1/16 inch to 2 inches and include all



View shows Quality Tool HSS End Mill

popular styles such as 2, 3, 4, 6 and 8 flutes; single and double end; short, long and extra long flute lengths: shell

end mills, ball end mills and corner rounding end mills are also included. Special sizes and styles are available on order. The end mills have polished flutes and double back off lands to give smooth, free cutting action.

For more data circle 100 on Postpaid Card

m m s

DIAL **INDICATORS**

Two precision dial indicators have been introduced by the L.



Starrett Dial Indicator

Every Plant needs (at least one)

TANK UNI

WRITE FOR FREE GUSHER TANK UNIT BULLETIN.

Gusher Tank Units are precision built, efficient Coolant

systems that may be used on any machine tool. Fully portable Gusher Tank Units can be moved from machine to machine, and come in many sizes and H.P.

Gusher Coolant Pumps are also available in a full line of O.E.M. Units.

MACHINERY CO.

- COOLANT PUMPS
- CIRCULATORS . AGITATOR
- . MOLTEN METAL PUMPS

1817 READING ROAD CINCINNATI 2, OHIO For more data circle 453 on Postpaid Card

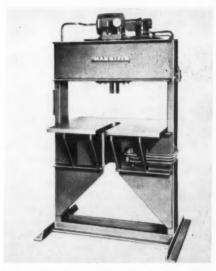
S. Starrett Co., Athol, Mass., which are said to have an accuracy of plus or minus 0.00005 inch for the 0.015 inch total range (2½ turns). The Starrett No. 25-109 is a balanced dial indicator with a range of 0-3-0, one revolution 0.006 inch, total range 0.015 inch. The Starrett No. 25-209 is a continuous dial model, reading 0-6, one revolution 0.006 inch, total range 0.015 inch. Both indicators are furnished with jeweled bearings.

For more data circle 101 on Postpaid Card

★ modern machine shop ★

UTILITY PRESSES

A line of hydraulic ram type or guided platen industrial utility presses has been announced by Hannifin Co., Dept. 166, 501 South Wolf Rd., Des Plaines, Illinois. The presses feature a "component selection" concept which makes possible a broad choice of standard frames, working forces,



View of Hannifin Series "I" Utility Press

speeds, circuits, controls and power sources. The presses can be designed

MITRE TUBING and SHAPES this fast. Economical way!

GET close-fitting, true mitre joints, ready for brazing or welding, without filing or deburring. It's simple with a Vogel MITRE-SNUG. Unit combines two cutting operations in one

allowing round or square tubing and preformed shapes to be mitred in a single press stroke.

This is done by feeding the tubing or stock into the left and right-hand dies successively—two pieces at a time . . . For complete information on this and other cost-saving tools, see your Vogel Dealer or contact:

VOGEL TOOL and DIE CORPORATION

1823 N. 32nd Avenue Stone Park, Illinois
Manufacturers of ARC-FIT, ARC-TWIN, ARC-SNUG, MITRE-SNUG,
YOBEL CUT-OFF and PERF-ARC (Piercing and Perforating Equipment).



for specialized production jobs by simply selecting the proper combination of standard components to meet preset requirements.

The Hannifin Series "I" Utility Presses have structural steel frames which meet NMTBA deflection standards, 25, 50, 75 and 100 ton capacities are offered in both ram type and guided platen models with a choice of 24 by 24 inch or 36 by 24 inch die areas. Seven power sources are available to provide a wide range of press speeds. For example, the 25 ton model with the lowest capacity power source will operate at 70 i.p.m. advance, 31 i.p.m. feed, 55 i.p.m. return; with the largest capacity power source, speeds increase to 1080 i.p.m. advance, 125 i.p.m. feed, 865 i.p.m. return, Hannifin also offers seven electrical control systems for the Series "I" Press as well as manual control and sensitive

pressure control. This line of presses was designed to permit a wide variation of choices from basic components, thus achieving a "custom" design.

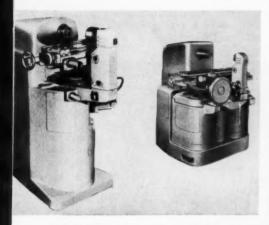
For more data circle 102 on Postpaid Card

★ modern machine shop ★

COMPARATORS

Large area lenses and generous machine capacity are combined in two direct projection comparators now being offered by Jones & Lamson Machine Company, 521 Clinton St., Springfield, Vermont which are used in a dark or semi-dark room. Shadow images may be viewed on any suitable flat surface. The Model DPC has a single column support and a measuring capacity of 4 inches vertically, and 5 or 8 inches horizontally depending on the work table selected. The Model DPC-ER has double column support and a measuring capacity of 8 inches vertically and 10 inches horizontally.





J & L (Left) Model DPC and (Right) Model DPC-ER Direct Projection Comparators

Both models are said to give full, accurate coverage up to 60 inch screen size at all magnifications. Standard (FC-30) lenses are provided for magnifications from 5X to 100X. Powers above 100X are also available for special applications. The J & L Direct Projection Comparators are used for the measurement and inspection of a wide range of parts, including gas turbine blades; wind tunnel aircraft models; hob and milling cutters; templates and contour turned parts. For more data circle 103 on Postpaid Card

★ modern machine shop ★

TAPE CONTROLLED PRINTED CIRCUIT BOARD DRILLING MACHINE

A machine designed to drill printed circuit boards of a wide variety of materials and thicknesses has been developed by Edlund Machinery Co., 37 Huntington St., Cortland, N. Y. According to the manufacturer, this is a high production, highly versatile machine performing drilling operations with great accuracy. It is a numerically controlled, tape programmed



October, 1961

MODERN MACHINE SHOP

209

driller consisting of a tape controlled point-positioning table and 4 drilling clusters, each with 4 independent air feed drill units.

The high production is a direct result of the "4 in 1" drilling operation. In effect, the 4 clusters act as 4 coordinated drilling units eliminating the high costs of individual control systems, bases, and power plants for each unit. Under average conditions, the driller operates at 50 cycles per minute and drills 4 boards at once, resulting in 200 holes per minute. If four boards are stacked, 16 can be drilled at once, achieving a proportionate increase in production. The versatility of the machine permits rapid changes in drill size and speed. Each cluster consists of 4 independent units which may be fitted with differ-

ent size drills and rotated at different speeds up to 22,000 r. p. m. Since these are tape controlled. the changes are automatic, eliminating slow and inefficient manual retooling. The inherent flexibility of the tape programmed operation is another time saver, since additions or deletions to the tape can usually be made in a matter of minutes, providing for a quick "tooling up" job.

The Point Positioning table is also tape controlled. It has a travel of 14 by 20 inches per minute and a flat working surface of 18 by 44 inches. It is built with a 2 inch zero offset in each axis, allowing the table movement needed



NO GRINDING



ROLLER BURNISHING TOOL

Using any shop machine you now have, and the Wiedeke IDEAL Roller Burnishing Tool you should have — even an inexperienced operator can put a 4-15 micro-inch surface finish in bored or reamed holes. Mount the tool on a lathe, drill press, screw machine, etc., make one simple micrometer-accurate adjustment, then turn out hundreds of precision-finished pieces per hour. The facts about this tool are interesting, the savings you can make are even more so; write, now, for complete information.

The Gustav

WIEDEKE

DAYTON 1, OHIO

quality cold-rolling tools since 1892
For more data circle 462 on Postpaid Card

and Round Shanks
for
THROUGH HOLE
BLIND END and
SPECIALIZED
BURNISHING
Self-Feeding
Rolls Retract
Automatically
NOMINAL SIZES
.312" - .484"
Adjustment Range
-.003" - +.017"

No. 1, 2, 3 M. T.

Company

.500" - 8.000"

Adjustment Range

-.004"-+.037



Edlund Model NPB Printed Circuit Board Drilling Machine Numerically Controlled

for changing to different drill sizes. A special rapid backlash settling device is included to provide rapid table positioning. The machine was designed for use with a General Electric Mark II Numerical Positioning Control having buffer storage and fast reading. However, it is also available with a standard Mark II without the buffer storage. Edlund also offers a Tape Programmer, Model TPR, to be used in connection with the drilling machine. This completely independent unit prepares conventional 1 inch wide 8 channel tape directly from art work, locating up to 30 positions per minute easily and accurately. It is extremely versatile handling grid sizes down to 0.025 inch including unusual sizes such as 0.14 inch and grids that vary from the "X" to "Y" axis.
For more data circle 104 on Postpaid Card

modern machine shop *

OPTICAL GAGE

The DR-25B Optical Gage, which is said to provide absolute measurements to tenths for routine production, has been developed by Bausch & Lomb. Inc., 83919 Bausch St., Rochester 2, N. Y. The instrument is accurate to

ANYTHING NEW IN DIAMOND WHEELS?



INCREASE WHEEL LIFE 50%

You can remove more stock, faster, with less wheel wear, when you use the new PRECISION "BH" Resinoid Bonded Tool and Cutter Diamond Wheels.

This is another PRECISION first in industry. By radically new production methods, the diamond cutting particles are attached to the resinoid bond. It wets and holds the diamonds. Users report up to 50% increased wheel life. Ask for and try the following grade: MD150 N100 BH.

SEND US SATIFACTION GUARANTEED ORDERS. MAKE US PROVE THESE FACTS.



For more data circle 463 on Postpaid Card

WANTED!

Oldest Thor Power Screwdriver Still in Service

\$100 REWARD!

Thor will pay a reward of \$100 for information leading to the location of the OLDEST THOR POWER SCREWDRIVER STILL IN SERVICE (Air or Electric). Submit Model Number, Serial Number, Application. Write: J. L. MacDonald, Training Director, Dept. 17, Thor Power Tool Co., Aurora, Ill.

For more data circle 464 on Postpaid Card

DI-ACRO



SPRING WINDER

wind your own springs FAST, EASY, ACCURATE

- · Winds one or hundreds of any spring
- · Makes any length springs
- Winds flat, round, square and rectangular wire
- Forms any gauge wire to 1/8" diameter
- Moves easily to any location. 30 lb.
 —23½"x8½". Bench or vise mounted.

See your Di-Acro dealer or write for information and prices.

Ji-acro

pronounced "die-ack-ro"

DI-ACRO CORPORATION

formerly O'Neil-Irwin Mfg. Co. 7510W. Eighth Ave. • Lake City, Minn.

For more data circle 465 on Postpaid Card

new equipmen? . . .

0.000025 inch and operates within normal temperature ranges without correction tables. The DR-25B measures parts directly. The instrument incorporates a precision ruled scale (not subject to error from wear) and is ideally suited for the gaging of parts on which a number of dimensions must be checked. The design of the unit permits it to be operated accurately within the 40 degree temperature range (50-90 degrees) most common to industrial areas, without further temperature adjustments. Consequently, it has extensive, practical application in both production and receiving areas. At the same time, it will provide the high degree of accuracy required in a precision gage laboratory or toolroom.

The inherent accuracy of the DR-25B is largely due to its high precision Bausch & Lomb scale. Precision measurements can be made from 0 to 3 inches. Over a temperature range of



View of Bausch & Lomb DR-25B Optical Gage

from 31 to 105 degrees, the maximum correction for a three inch dimension in steel is only 0.0001 inch. Each instrument is supplied with an anvil adapter which will accept any standard anvil or special fixture. A 3.5 inch diameter circular, serrated anvil and a 4 by 6 inch rectangular, serrated anvil is available as optional equipment. The unit has been designed for a foot control switch (optional) which frees the operator's hand for manipulating parts.

The DR-25B is supplied with a standard spindle tip, but any AGD tip can be accommodated. An optical fine adjustment is provided to precisely zero the instrument by simply turning a knob. The DR-25B's light weight (60 pounds) and compact housing (21¼ inches by 11¾ inches by 10¾ inches) gives it unusual portability for instruments of this type. All components are completely enclosed to protect against dirt, moisture and

vibration. The two-tone light gray epoxy finish resists stains and is easy to keep clean.

For more data circle 105 on Postpaid Card

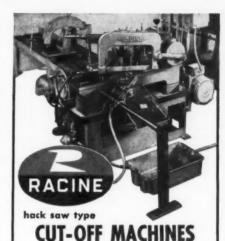
* modern machine shop *

DRILL BUSHING TIPS AND ADAPTERS

A special Keller-Type Drill Bushing Tip being marketed by Ace Drill



View of Ace Keller-Type Drill Bushing Tip



save you man-hours

- · Saws without supervision
- Easy stock positioning; simple control
- · Fast set-up, and easy blade changing
- · Air- and hydraulic-operated vises
- Automatic stock feeds for multiple bars

reduce your cost per-piece

- · Self-adjusts to fastest feeds
- Accuracy to .005"; angles to 45°
- · Shear-action stroke cuts maximum metal
- Lift on return lengthens blade life
- Cut one or 1000 pieces . . . mild, alloy, and die steels; exotic and non-ferrous metals
- · Choice of 2-, 4-, and 6-speed drives

dependable for long life

- · Oil-smooth hydraulic-powered feed
- Extra-large bearings . . . 90% self-lube
- · Require little adjusting
- Product of 50 years' experience and continuous engineering improvements

Production and job-shop models, 6" x 6" to 24" x 24", wet or dry

Free information Write today for full details and name of nearby dealer, to:



Racine Hydraulics & Machinery, Inc.

Department K291, Racine, Wisconsin

For more data circle 466 on Postpaid Card

Bushing Co., 5407 Fountain Ave., Los Angeles 29, Calif., provides a fast, accurate method for fast mounting of portable or stationary air-feed drilling, tapping, back spotfacing or other self-contained machining units on a jig or fixture. The threaded end of the Ace-Keller Drill Bushing Tip screws into the nose end of the drilling unit. Locking flanges on the tip fit firmly under the shoulders of the lock-screws or lock strips on the jig, holding the drilling unit securely in alignment, and absorbing both the thrust and torque.

Ace also produces precision adapter tips and lock liner bushings for embedment in plastic, fiberglacs or other soft, non-ferrous materials. A close tolerance is maintained when drilling rivet holes in stainless steel, titanium, nickel and other hard or exotic metals. For more data circle 106 on Postpaid Card

★ modern machine shop ★

ADDITIVE PREVENTS FLAWS IN ALLOY INGOTS

Crane Packing Co., Dept. PF-3, 6400 Oakton St., Morton Grove, Ill., has introduced an additive which is said to prevent flaws and produce improved stainless steel and other alloy ingots. Known as Smelter-Aid, it actually purges out oxygen and hydrogen during pouring, thus minimizing scalding and pitting. This results in more homogeneous ingots, elimination of

High-Output with ROUSSELLE

DOUBLE-CRANK PRESSES



"Econo-Air" clutch.

SPEED UP PRODUCTION with these versatile 40-ton presses. Large bed and ram areas make them ideally suited to handle wide rolls or sheets . . . do multiple punching, steel-rule die work and other high output operations. For rapid, shockless starting and stopping, presses can be equipped with electrically controlled "Econo-Air" friction clutch . . . Ask for new catalog.



STRAIGHT SIDE - Die space up to 24 in.; bed space up to 6 ft. between uprights.

Choice of over 30 models and types in 5 to 60-ton sizes

SERVICE MACHINE COMPANY

Mfrs. of Rousselle Presses

2310 WEST 78TH STREET . CHICAGO 20. ILLINOIS

Rousselle Presses are sold exclusively through Leading Machinery Dealers.

For more data circle 467 on Postpaid Card



Ingot (A) in foreground is untreated, whereas ingot (B) was Smelter-Aid treated.

rejects due to internal flaws or surface imperfections and subsequent resmeltering.

The additive is available in either granular or molded ring form. It is simple to use; merely drop a 4 oz. self-dissolving polyethylene bag of granules into the mold for each 500 lb. of metal being poured or submerge a ring of Smelter-Aid directly into the ladle. Smelter-Aid's chemical reaction does the rest.

For more data circle 107 on Postpaid Card

* modern machine shop *

RADIUS DRESSER

Somerset Tool Co., 320 Virginia St., Hillside, N. J., has announced that its Model "SS" Radius Dresser has been newly engineered and redesigned to enlarge its capacity. The Model "SS" dresses all abrasive wheels up to and including 14 inches in diameter, with an accuracy of 0.0002 inch.

Open and easy-to-see operation means that convex, concave, and complex combination shapes are said to be easily and quickly dressed by even

· TROYKE ·

ROTARY TABLES

A Size and Model for Every Need

Model R-21

Model U-15-4



HORIZONTAL Sizes 9", 12", 15", 18", 21", 25"



HORIZONTAL and VERTICAL Sizes 9", 12", 15"



CROSS SLIDE ROTARY TABLE 12" x 12" Working Surface



Model CS-12

CROSS SLIDE TABLE
12" x 12" Working Surface

Cross-slide accuracy: within .001" total in 10" of travel.

Angular accuracy 60 seconds or less on all models.

WRITE FOR CATALOG

"Rotary Tables Are Our Business"

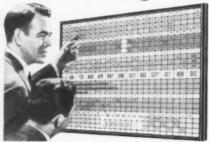
TROYKE MFG. CO.

Cincinnati 41, Ohio

For more data circle 468 on Postpaid Card

MODERN MACHINE SHOP 215

How To Get Things Done



BOARDMASTER VISUAL CONTROL

Your operations are pictured at a glance. You save time, money and prevent mixups by Seeing What is Happening at all times. Ideal for Production, Maintenance, Inventory, Scheduling, Sales, Etc. [1950] Easy to Use. You write on cards, snap on metal board. Over 750,000 in Use.

FREE

24-Page BOOKLET No.MS-50 Mailed Without Obligation

GRAPHIC SYSTEMS

925 Danville Road • Yanceyville, N.C. For more data circle 469 on Postpaid Card

POWER FEED FOR SPEED—
EXCELLENT LOW COST UNITS FOR—
BRIDGEPORT (BOTH LONG & CROSS)
U. S. BURKE "MILLRITE"
GORTON "MASTERMIL" 1-22
ROCKFORD MV 100
HANCHETT "MAG MILL"
CLAUSING & OTHER POPULAR
MILLING MACHINES

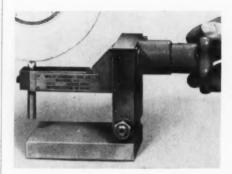


ALSO RAPID TRAVERSE UNIT FOR \$8750
BRIDGEPORT, GORTON & OTHERS
35 LBS. WITH COLLET RACK



For more data circle 470 on Postpaid Card

new equipment . . .



View of Somerset Model "SS" Radius Dresser

inexperienced operators. Since the wheel is dressed from below, the need to remove the wheel guard is eliminated, increasing the safety margin of the dressing operation. Four stop pins allow complete adjustment from 90 through 180 degrees. The diamond dressing point is easily set by measuring with a micrometer from the top of the measuring hood to the bottom of the dresser arm.

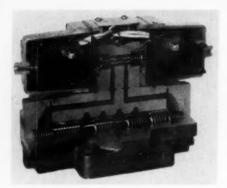
For more data circle 108 on Postpaid Card

* modern machine shop *

CONTROL VALVES

Racine Hydraulics & Machinery, Inc., 2000 Albert St., Racine, Wis., has introduced a series of piggyback fourway directional control valves featuring reduced piping, and designed to meet a wide variety of applications with pressures up to 3,000 p.s.i. The valves are sized at ½, ¾ and ¾ inch; the latter two units are also available with ½ inch and 1 inch subplates respectively.

A design highlight of the Racine Series is the availability of an internal drain. This eliminates the external drain line and the need for a fifth port, with resultant decrease in piping for most systems. Full pressure at all



Racine Series of Piggyback Control Valves

ports, including drain, is permissible. New on these units is a flow control manifold adaptable to the valve base for metering the speed of single or double-acting cylinders or fluid motors. Also available are pilot choke and spool stroke adjustments.

For more data circle 109 on Postpaid Card

MACHINABLE CARBIDE

Ferro-Tic J, a cutting grade carbide. has been announced by Chromalloy Corp., Sintercast Div., 169 Western Highway, West Nyack, N. Y. The J-Series is said to be the first to combine the hot hardness required in high speed metal cutting with the easy fabrication feature of earlier grades of Ferro-Tic. In the annealed, asreceived state, this sintered composite of ultrahard carbide particles dispersed in a high speed steel matrix, the company states, can be turned, drilled, milled, tapped or even filed. Once heat treated up to Rockwell C-70, the tool blank behaves like a solid carbide.

Because of its unusual wear resistance. Ferro-Tic J is well suited as an insert for milling cutters and end mills. fly cutters, drills, broaches, form tools, and others requiring long life or intricate shapes. The material may be used to cut ferrous alloys, as well as a wide

IEW MODEL 70 MULTI-WHEEL NUMBERING MACHINE



MODEL 50 Automatic Numbering Head. Write for catalog MS-50.

The most efficient method of stamping numbers into metal. Repeats the same numbers until changed. Model 70 NUMBERALL machines are used in all industries to mark various parts. Stamps numbers, etc., quickly . . . neatly. Much better marks are produced by these machines than by single stamps or steel type, and at a far lower cost. Shank for Hand or Press and with any number of wheels from 3 to 20. Can be furnished in 1/32" to 3/8" high figures, sharp face gothic or shaded roman style. Write for Bulletin MS-70. We also make other numbering heads, non-automatic, with quick-set wheels.

Write for catalogs MS-80, MS-83 and MS-85. Steel Type and Wheels Available with Round Face Characters.



NUMBERALL STAMP & TOOL CO. HUGUENOT PARK STATEN ISLAND 12, N. Y.

Hand shank Model 70 illustrated, Press shank for foot or power presses also available.

For more data circle 471 on Postpaid Card

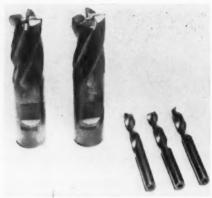


Write today for your copy and see for yourself. D TOOL SUPPLY CO



For more data circle 473 on Postpaid Card

new equipment . . .



Drills and end mills are easily produced out of a new machinable carbide. Ferro-Tic J

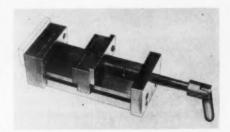
range of non-ferrous and non-metallic materials. Cutting speeds of 100 to 200 surface feet per minute on semi-hard alloys are said to be readily possible without damaging the tool.

For more data circle 110 on Postpaid Card

modern machine shop *

TOOLMAKER'S VISE

A precision-ground toolmaker's vise, featuring an extra large jaw opening of six inches and a jaw width of three inches, has been introduced by The Bald Eagle Products Co., 60 East 4th St., St. Paul 1, Minn, The vise is



View shows Bald Eagle Toolmaker's Vise

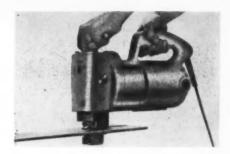
hardened and ground to 0.0002 inch in parallelism.

To permit greater flexibility in handling a wide variety of sizes of workpieces, the vise utilizes removable hardened and ground jaws with inside and outside jaw positions. It is constructed of special stress relieved steel for lasting accuracy. The swivel-tail handle swings out of the way when the vise is in use and provides for easy tightening when used in close quarters. For more data circle 111 on Postpaid Card



GOBBLER

Modern Manufacturing Co., Inc., 680 Davisville Rd., Willow Grove, Pa., has announced the introduction of the Modern Gobbler which, the company states, will cut ½ inch c.r.s., 7/32 inch stainless steel, and ¾ inch aluminum. The tool employs a feature called



View shows Modern Gobbler Model SN-40

variable torque which gives the operator variable strokes for cutting different thicknesses of material. By having this variable stroke, the greatest power is exerted when cutting stainless steel with a small stroke.

The Modern Gobbler, known as Model SN-40, also has a carbide die, built-in lubricator and built-in circuit breaker

For more data circle 112 on Postpaid Card



For more data circle 474 on Postpaid Card

PRESS BRAKES

Dreis & Krump Manufacturing Co., 7418 South Loomis Blvd., Chicago 36, Ill., has announced a line of hydraulic press brakes with many exclusive features for simple, accurate control and operator convenience. The brakes are offered in 42 standard sizes from 100



ADJUSTABLE CLAMP COMPANY "The Clamp Folks"

436 N. Ashland Ave. Chicago 22, III.
For more data circle 475 on Postpaid Card



Optional SWIVEL BASE converts a conventional dividing head into a universal work head or rotary table. Change-over is accomplished in seconds without tools or wrenches.

Also available in 10" - 12" sizes and in 10" - 12" spiral drive.

Write for Catalog

CARROLL DIVIDING HEAD CO. 3525 Cardiff Ave. • Cincinnoti, Ohio

For more data circle 476 on Postpaid Card



Model 210H10 Chicago Hydraulic Press Brake

ton to 1000 ton capacity. For capacities from 1000 to 2000 tons the specifications are developed to suit individual requirements.

Some of the features on the Chicago Hydraulic Press Brakes are: proved, precision built, variable-delivery oilgear pumps with simplified valve and piping circuit; ultrafine electronic sensing for precision ram-leveling control; compact panel with low-voltage control; infinitely variable ram speeds within the specification limits and zero-positioning.

For more data circle 113 on Postpaid Card

ALEM ADMICTABLE DURBUNG TOOL

NEW ADJUSTABLE BURRING TOOL . . .

a handy vest pocket scraper and burring instrument. Blades are fully retractable, replaceable and easily sharpened. Cutting length adjustable to 3", can be reversed to use other end. Made from hi-quality, hi-speed tool steel for lang life. Ideal for burring in aircraft and other light metal operations—overall length 4½". Complete \$2.80 each. Min. order 6—Blades \$1.25 each

te \$2.80 each. Min. order 6—Blades \$1.25 each
Write for Additional Information.

Dealer Inquiries Invited.

TITAN TOOL SUPPLY CO.
Box B, 68 Comet Ave., Buffalo 16, N. Y.

For more data circle 477 on Postpaid Card

AIR-OPERATED DIAPHRAGM CHUCK

An air-operated diaphragm chuck announced by Erickson Tool Co., 34358 Solon Rd., Solon, Ohio, has extra-short overhang and special hardened and ground master jaws. The quick acting unit is said to provide high speed chucking with repetitive accuracy in very low tenths. The workpiece is chucked and released by compressed air operating on a piston which flexes the steel diaphragm, opening the jaws the necessary few thousandths of an inch. When pressure is removed, the diaphragm flatens, closing the jaws and gripping the work. Chucks can be constructed with a double acting piston for push-pull operation where additional grip is needed. Very high concentricity accuracy is a characteristic of Erickson Diaphragm Chucks.

Normally, Erickson diaphragm chucks have a jaw-holding assembly



Erickson Air-Operated Diaphragm Chuck

mounted directly on the diaphragm plate. Soft interchangeable jaws, adapting the chuck to a wide range of work sizes, are machined in place. The new chucks, however, employ one of two available styles of special master jaws. These are hardened and ground for repeat precision over a long service life. Such jaw sets for different jobs are interchangeable and may be changed without affecting accuracy.

Erickson air-operated diaphragm

MAGNETS



FOR HUNDREDS OF USES TO CUT PRODUCTION COSTS

Permanent Alnico Magnets will hold steel parts thru' every stage of production . . . on conveyor lines, in tanks and paint booths . . . as holders in various machining operations, as sheet steel separators and as devices for retrieving parts or cleaning up metal shavings, etc.

There are hundreds of money saving uses for Empire Permanent Magnets and your first cost is the last cost.

WRITE FOR NEW CATALOG AND MONEY SAVING MAGNET IDEAS



113 EAST CLINTON ST. MAUMEE, OHIO

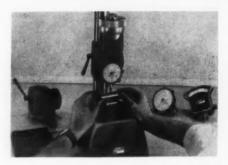
For more data circle 478 on Postpaid Card

chucks for internal or external chucking, are made in $5\frac{1}{2}$ inch diameter 3-jaw models, 7-inch diameter 4-jaw and 10 inch diameter 6-jaw sizes. These chucks are frequently engineered special to suit specific work.

* modern machine shop *

MULTI-CHOICE COMPARATOR

A versatile, high precision comparator, offering a wide selection of gaging methods and accessories, has been announced by Federal Products Corp., 1147 Eddy St., Providence 1, R. I. The basic unit of the comparator is a sturdy base and precision column on which can be assembled your choice of dial indicator gaging units or air, electric, or electronic gage heads. Increasing the adaptability of the



View of Federal Multi-Choice Comparator

comparator are a variety of interchangeable reference surfaces.

One useful combination features a micrometer head with a 0.0001 inch dial indicator. By utilizing the one inch range of the micrometer, settings up to 8 inches can be made using just three gage blocks (1, 2, and 4 inches). The alternative holding arm has a fine adjustment with no play or backlash,





For more data circle 480 on Postpaid Card

For more data circle 479 on Postpaid Card

and is used for other dial gaging arrangements as well as the air, electric, and electronic heads. Among the choices of reference surfaces are a reversible anvil, a serrated platen, a roller vee block, and precision centers. For more data circle 115 on Postpaid Card

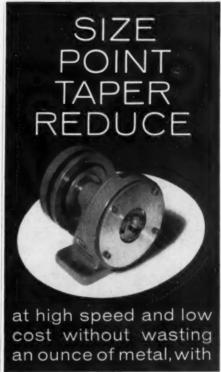
* modern machine shop *

WHEEL CRUSHER FOR R-O FORM RELIEF EQUIPMENT

R-O Manufacturing Co., 31171 Stephenson Highway, Madison Heights, Mich., is now offering wheel crushers for use on R-O universal form relieving equipment. These crushers are available in two types: one is the collet held crusher which requires that the work be removed from the collet. although setup of the fixture is not disturbed; the second type crusher, which can only be used where the nature of the work permits, is machined as a part of the arbor on which the work is held. With this type crusher, nothing is involved in redressing the wheel except to slide the table so that the crusher form is brought opposite the wheel. After dressing, the table is moved to bring the work back to position. For more data circle 116 on Postpaid Card



Wheel Crusher for R-O Form Relief Equipment



BENCH MODEL SWAGERS

Torrington Precision Swagers will save time, money and material in countless forming and assembly operations in your metalworking shop. Write for complete information on our full line of swaging machines — large and small.

largest maker and user of rotary swaging machines

THE TORRINGTON COMPANY

Torrington, Connecticut

For more data circle 481 on Postpaid Card

MODERN MACHINE SHOP

223

October, 1961

COOLANT SUPPLY UNITS

Brown & Sharpe Mfg. Co., Providence 1, R. I., has announced two tank and pump units for supplying coolant to machine tools. Tanks are 16 and 32 gallon capacity with two baffles to aid in settling chips and sludge. Welded steel body and cover provides rigid

The STEVENS Line SINCE 1925 Introducing NEW series



ROTARY TABLES _______5-8-12-15-18-24" sizes both standard and dial indexing types ADJUSTABLE TILTING TABLES _____#0-1-2 COMPOUND TABLES ____#1-1½-2 ROTARY-COMPOUND TABLES ___#1-1½-2 INDEX CENTERS—multiple spindle SPECIAL MACHINES—designed and built

See your dealer or write for bulletins

The John B. Stevens Company Main Street, Somersville, Conn., U. S. A.

For more data circle 482 on Postpaid Card



B & S Coolant Tank with Midget Hi-Flo Pump

assembly. The units are available with swivel casters or welded steel legs optional.

Tanks are equipped with the ½ h.p. Brown & Sharpe Midget Hi-Flo Centrifugal Pump which circulates a copious flow of water soluble coolant or cutting oil up to 300 S.S.U. viscosity. Volumes of 20 g.p.m. at 7 foot head or 10 g.p.m. at 14 foot head are available from the pump unit. The pump motors are available for standard electric current ratings.

For more data circle 117 on Postpaid Card

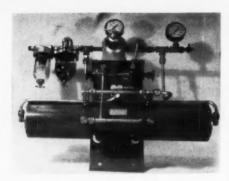
* modern machine shop *

BOOSTER PUMP

The Dayton Rogers Manufacturing Co., Minneapolis 7, Minn., has an-



For more data circle 483 on Postpaid Card



Dayton Rogers Pneumatic Booster Pump

nounced a pneumatic booster pump in two sizes. Quite often it is necessary to boost the shop air line up to two and three times the present pressure. This can be done by applying the booster pump to any location on the shop line to get the desired pressure at the point of operation.

It is quite practical in a number of cases, where there is a drop in the shop air line pressure, to introduce one of these pumps so that the pressure at the point of operation is assured during the application of the air pressure on a given piece of equipment. The self-contained unit will produce a maximum output pressure of 300 p.s.i. on an air line of 80 p.s.i. All necessary fittings, line filters, lubricators and gauges are included in the one power package.

For more data circle 118 on Postpaid Card

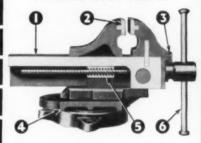
★ modern machine shop ★

TAPE-CONTROLLED BORING AND DRILLING MACHINE

The American Tool Works Co., Pearl St. at Eggleston Ave., Cincinnati 2, Ohio, has announced the offer of a package arrangement including an 11 inch column boring and drilling machine combined with a numerically controlled ultra-precision positioning table. Called The 511-12 Semi-Auto-

VISE FEATURES

- 1. exclusive steel slide milled from solid bar
- replaceable jaw inserts held by top-entering pins
- 3. outside screw retainer



- 4. positive locking 360° swivel base
- 5. longest wearing alloy steel nut
- 6. one-piece non-pinch handle

SOLID STEEL SLIDE

Simplex industrial vises give you the advantage of solid steel slides, jaws, nuts for maximum strength and ruggedness long after their modest cost is written off. Line includes milling machine, pipe, sheet metal and other models.

Desmond Simplex

The Desmond-Stephan Mfg. Co. Urbana, Ohio

For more data circle 484 on Postpaid Card

PRODUCTION PRECISION

GRAND RAPIDS MODEL F
PRODUCTION GRINDER



MODEL F HYDRAULIC FEED SURFACE GRINDER, a production type with cross sliding head, built in sizes ranging from 12" x 18" x 48" to 30" x 25" x 120". A heavy, powerful grinder with maximum table speeds of 150' per minute. Motor mounted directly on grinding wheel spindle to assure that full power is transmitted directly to wheel. The machine illustrated is equipped with automatic downfeed which can be set

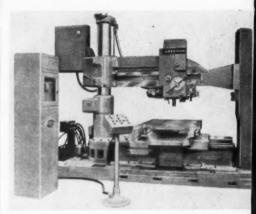
to remove stock in increments from .0001 to .001 per table reversal.



New literature gives all the facts. Write for your copy.

GALLMEYER & LIVINGSTON CO. 408 Straight Ave., S. W., Grand Rapids, Mich.

new equipment . . .



American 511-12 Semi-Automatic Boring, Drilling, Reaming and Tapping Machine

matic Precision Boring, Drilling, Reaming and Tapping Machine, the machine includes a tape controlled automatic spindle cycle, formerly special but now standard equipment. After dials are manually set, controls on the unit automatically traverse the spindle to the workpiece, feed it to a preselected depth, then traverse it back to the starting point. This cycle continues automatically until a tool change becomes necessary.

The spindle and sleeve are precision boring mill type, of nitrided Nitralloy steel, and honed to 0.0002 inch sliding fit. Drive to the spindle, which is mounted on opposed precision Timken bearings, is through double keys in the sleeve. Spindle travel is 12 inches while the maximum distance of the spindle to the table top is 3734 inches. Twelve power feeds give from

GRAND RAPIDS

For more data circle 485 on Postpaid Card

0.001 to 0.025 inch per revolution. Twelve spindle speeds are provided with a choice of three ranges including 30 to 1500 r.p.m., 45 to 2250 r.p.m. and 60 to 3000 r.p.m. The main drive motor is 7½ h.p.

The ultra-precision positioning table travels 30 inches on each axis, and has a positioning accuracy of plus or minus 0.00025 inch with repeatability of plus or minus 0.000050 inch. Numerically controlled by punched tape, the table is positioned hydraulically. An outboard support adds to the rigidity of the entire unit.

For more data circle 119 on Postpaid Card

* modern machine shop *

PIN AND KEYSTOCK ASSORTMENTS

John Gillen Company, 2542 South 50th Ave., Cicero 50, Ill., has packaged an assortment of dowel, tension, taper and groove pins, woodruff keys, and



Pin and Keystock Assortments in Metal Kit

TOOLROOM PRECISION

GRAND RAPIDS MODEL1230 O.D. & I.D. GRINDER



NO. 1230 HYDRAULIC FEED O.D. AND I.D. GRINDER meets the needs of users requiring a machine that does both internal and cylindrical grinding. It is a rugged, precision tool capable of taking rough cuts as well as producing the finest finish. Longitudinal table movement is controlled by valve or by hand wheel. Cross feed is actuated by hand wheel. Magnetic starters are furnished for each

Write for copy of latest literature with complete details.



GALLMEYER & LIVINGSTON CO.

408 Straight Ave., S. W., Grand Rapids, Mich.

GRINDERS

GALLMEYER

For more data circle 486 on Postpaid Card

motor.

12 inch lengths of keystock and pinstock. A total of 422 pieces are in a strong partitioned metal box, with chart in lid, listing all lengths and diameters, popular sizes needed for repairs or replacement jobs.

The assortment is available as the result of requests from factory maintenance crews, machinery specialists, repair shops, and all those responsible for keeping many types of mechanical and electrical equipment in good operating condition.

For more data circle 120 on Postpaid Card

* modern machine shop *

ROTARY CAM SWITCH

General Automation Corp., 121 Centre Ave., Secaucus, N. J., has introduced a multi-stage cam switch which is available with one to six cams.



General Automation Rotary Cam Switch

The adjustment range is up to 180 degrees for each stage and can be adjusted quickly from the outside while the cams are stationary or in motion. The switch is designed primarily for any type of commercial equipment where a synchronous pulse or series of pulses is required, and where rapid adjustment is desired while the switch is in motion.

The switches are available in either clockwise or counter-clockwise rotation. Upon reversal, the switch will



VERTICAL

At last, a top quality industrial sander that provides all the most wanted features - yet sells for so little. \$99.95 complete with cord, plug, switch ready to use

Work table in vert. illus. optional.

Illustrated Literature on Request
A few desirable distributor territories still available

WALLS SALES CORPORATION
59-63 Van Dam St. Brooklyn 22, N. Y.

For more data circle 487 on Postpaid Card



For more data circle 488 on Postpaid Card

not trip (optional feature). It has heavy-duty, ballbearing construction throughout. The cams could be supplied with any degree of dwell. The switches are rated at 15 amps up to 480 volts a.c. Legend on the switches can be supplied to suit individual requirements. Typical applications are brakes, shears, power presses, lathes, millers, grinders, printing presses and so on.

For more data circle 121 on Postpaid Card

* modern machine shop *

INDEX TABLE

M & M Tool & Mfg. Co., 1123 East Third St., Dayton, Ohio, has announced a M-M 800 Roto Mill Electronic Index Table which is designed for automatic spacing of hole patterns in degrees, one-half degree or one-tenth degree increments. The M-M 800 can also be used for programming a part that requires milling of slots. By use



M-M 800 Roto Mill Electronic Index Table

of a 15 inch program plate, the M-M 800 can program uneven indexes.

With the M-M 800, the table can be programmed to the application. It can be used in a vertical or horizontal position. The M-M 800 is designed for drilling, boring, jig boring, checking, milling, spacing and many other

DRILL HARDENED STEELS WITHOUT ANNEALING -



With the new, improved "HARDSTEEL" Drill, you can do accurate, smooth drilling, countersinking, counterboring and reaming in steels hardened by any process without first annealing the work. And they work with equal ease on work-hardening steels and high carbon - high chrome steels of any degree of hardness. "HARDSTEEL" Drills fit standard drill presses. They save time and reduce

rejects. They permit engineering changes requiring additional drilling after hardening. And parts drilled after hardening always match at assembly. Write for a copy of the "HARDSTEEL" Operators Manual showing how "HARDSTEEL" Drills are cutting costs in thousands of plants.

BLACK DRILL COMPANY, INC.

YOU HARDEN IT - WE'LL DRILL IT WITH -

"HARDSTEEL"

For more data circle 489 on Postpaid Card

RIVET SPINNING



on the

is fast, low in cost and noiseless!

Produces finely finished rivets faster, even in close places. Send us samples of work to be riveted; without obligation we'll furnish you with a time and cost estimate doing if the Linley way.

Capacities: %" diameter rivets in iron and cold rolled steel; larger sizes in softer metals.

Send today for Bulletin R.

LINLEY BROTHERS CO.

Also builders of Jig Borers 671 State St. Ext., Bridgeport 1, Conn.

For more data circle 490 on Postpaid Card



CONTINUOUS HINGES

SPECIFICATIONS

Open width 3/4" to 12" Gage Material .040 to .187" Pin Diameter .093" to 1/2" Lengths to 1/44"

AUTO MOULDING & MFG. CO.

WRITE FOR CATALOG

1114 E. 87TH ST. .

CHICAGO 19

For more data circle 491 on Postpaid Card

new equipment . . .

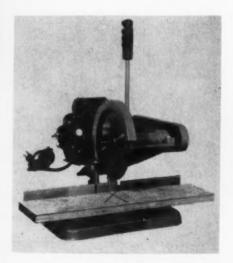
applications. It is powered with a 110-volt, 60 cycle motor, and a special slip clutch is provided for hand operation if needed.

For more data circle 122 on Postpaid Card

* modern machine shop *

CUT-OFF SAW

Beutler Machine Specialties, 5225 South Ashland Ave., Chicago 9, Ill., has introduced a cut-off saw. The chop type cut-off saw makes straight and miter cuts quickly and easily, and is particularly desirable in cutting thin walled extruded forms, as the blade is fed down into the work instead of across the work, reducing "hogging in." The saw can be used on all types of plastics, wood molding, trim, narrow flooring sheet metal, tubing, light angles and channels, and so on. The machine has a cutting capacity of 11/2 by 3 inch sections, and has a simple adjustment for cutting miters to 45 degrees left and right. Stop



View shows Beutler Chop Type Cut-Off Saw

adjustments are provided for top and bottom of stroke. The saw is lightweight which makes it easy to take it to the job. For more data circle 123 on Postpaid Card

* modern machine shop *

STOCK REEL

Cooper Weymouth, Inc., 600 Honeyspot Rd., Stratford, Conn., has announced a heavy duty automatic

centering spindle reel to its line of press equipment. The reel is designed for heavier and larger coils weighing up to 5,000 pounds, in both plain and motorized models with rugged. welded construction, steel base. All models have three support arms with quick adjustment keepers. Arms are the parallel rule type and easily adjustable from the front for a variety of coil inside diameters.

Plain models are equipped with electric brake and rheostat to prevent overrun of stock. A free loop arm control which fully releases and applies the brake is an optional extra. Motorized models have a gear head motor and the free loop

arm control is standard. The electric brake and rheostat controls can be supplied with motorized models if desired. The heavy duty stock reels are made in three stock width sizes—18 inches, 24 inches and 36 inches. The coil stock maximum weight is 5,000 pounds and maximum coil i.d. is 14 to 18 inches standard; 12 to 14 inches or 18 to 22 inch i.d. coil models can be supplied. Motorized models spindle speed is 12.8 revolutions per minute. For more data circle 124 on Postpaid Card



For more data circle 492 on Postpaid Card

MEASURING TOOL

The SPV Unimeter for comparative measurement has been announced by Homestrand Machine Tool Corp., 392 West Putnam Ave., Greenwich, Conn. The measuring jaw operates without play and friction and is spring



Homestrand SPV Unimeter Measuring Tool

actuated to give constant measuring

NEW! Self-Centering 5C Collet Stop

Quick friction adjustment. Stays in fixed position. Will not distort collet. Will not move back. Also available for other collets and spindles. 30 days Free Trial. Several Territories Open for Distributors. Write for Bulletin

THE BYSTROM COMPANY 6106 Park Ave. So. Minneapolis 17, Minn.

For more data circle 493 on Postpaid Card

action. After the reference dimension has been set up with gauge blocks or otherwise, unskilled personnel can measure accurately and quickly with the accuracy of the indicator being the limiting factor. Anvils are available for o.d., i.d., O-groove, V-groove and thread measuring. Ranges from 11/2 to 14 inches are available as standard. For more data circle 125 on Postpaid Card

modern machine shop *

FLUTED TOOLS Cutters . Millers . Taps . Reamers

MADE AUTOMATICALLY

Economically from Solids Get details on Miller and Grinder



For more data circle 494 on Postpaid Card

PLUG GAGE BLANKS

Huron Machine Products, Inc., P. O. Box 2274. Dearborn. Mich., is now offering taperlock plug gage blanks in high speed steel (not heat treated). The taperlock blanks are made to American Gage Design Standards and are available for immediate delivery. For more data circle 126 on Postpaid Card



IN 11 SIZES-No. 6 to 1" N.C. In all S.A.E. sizes.

Here is the faster, more precise way of transferring open and blind screw holes—make savings in "wage-dollars-per hour" of your expensive hands on every job. A die-and-tool maker's tool with many other applications for die makers and machinists. A set of 6 Hardened Screws nested in combination holder and wrench-no other tools needed. Get more work now-save money tool

MFG. CO. HEIMANN URBANA,

For more data circle 495 on Postpaid Card

DRILLS FOR PRINTED CIRCUIT BOARDS

A standard line of solid carbide drills designed primarily for use in stack drilling printed circuit boards on various high production type machines has been announced by Ace Drill Corp., Adrian, Mich. Designated Series 362-N, the drills feature a 118-120 degrees included point angle—with primary and secondary lip

relief angles of 6-7 degrees and 30-40 degrees respectively. These factors-plus the drills' 0.015 inch maximum webb at the pointcombine to permit fast, accurate drilling of smooth, burr-free holes in both epoxy and phenolic laminates. In addition, all drills in the line are finished with highly polished flutes and strong, sharp edges which are said to assure a faster. cleaner cutting action, high resistance to wear. and longer tool life.

While particularly suitable for high volume production of printed circuit boards, Series 362-N drills are also applicable to other operations and may be used with conventional

types of equipment. Drills are available in standard wire sizes from No. 1 through No. 72 inclusive and also in fractional sizes from $\frac{1}{4}$ inch down to $\frac{1}{32}$ inch in steps of $\frac{1}{64}$ inch. For more data circle 127 on Postpaid Card

* modern machine shop *

JIG BORING MACHINE

Linley Brothers Co., 661 State St., Extension, Bridgeport 1, Conn., has



Catalog No. 6, illustrating standard fixture clamps, jig and fixture details, from the industry's best known and largest manufacturer.

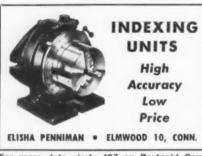
Complete and generous stocks of standard items are available from the Morton factory and strategically located warehouses, and distributors.

Call your local distributor, or write to the factory today, for your copy of this informative catalog.

MORTON MACHINE WORKS • Division Brubaker Tool Corp.

POST OFFICE BOX 231 • MILLERSBURG, PENNSYLVANIA

introduced an improved model of its jig boring machine designated as the Model 1A. The entire table and saddle assembly has been greatly increased in size and weight to give more rigidity and to improve balance characteristics through less lateral change in center of gravity, which is said to insure extreme accuracy of operation. Adding to the machine's ease of oper-



For more data circle 497 on Postpaid Card



View of Linley Model 1A Jig Boring Machine

ation are reference scales with large legible numbers and movable pointers which allow positioning without counting hand wheel turns. The table size and movement is 7 by 71/2 inches and 61/2 by 10 inches respectively.

Square edged ways, positive no-shift table and saddle locks, 3/8 inch standard tee slots and easy individual gib adjustment with Helicoil self locking type inserts are some of the other features of the improved Linley Model 1A Jig Boring Machine.

For more data circle 128 on Postpaid Card

modern machine shop *

REMARKABLE SAVINGS



For more data circle 498 on Postpaid Card

VERNON DEVICES, INC.

481 East 3rd Street, Mt. Vernon, N. Y.

SERVICE TRUCK **FACILITATES MOVEMENT** OF TOOLS AND EQUIPMENT

Bay Products Div., American Metal Works, Inc., 1827 West Cambria St., Philadelphia 32, Pa., has introduced a line of heavy duty service trucks made particularly for easy movement of tools and equipment wherever re-



For more data circle 499 on Postpaid Card



Bay Service Truck with drawers which facilitates movement of tools and equipment

quired. In addition they are now available with drawers which can be padlocked. This insures that whatever is required will be kept constantly at hand. Trucks are available in either an 18 by 30 inch tray size for narrow aisles or a 24 by 36 inch tray size for large loads. Each unit is equipped with 5 inch diameter easy-roll rubber tread casters, two rigid and two swivel, and a tubular push handle. Construction is all steel with gray baked enamel finish.

For for data circle 129 on Postpaid Card

* modern machine shop *

BORING HEAD

Giddings & Lewis Machine Tool Co., 142 Doty St., Fond du Lac, Wis., has added a continuous radial feed head, the CF-6E, to its Davis "CF" line of precision heads for small diameter boring, facing, turning, backfacing, grooving, and chamfering operations. It provides four inches of uninterrupted radial tool feed and the boring range is from 7/16 inch (with pencil boring tools) to a recommend-



"TRICO-MIST"

COOLANT SYSTEM
Increase Production And Tool
Life As Much As 500%.



For drilling, tapping, milling, sawing, grinding, etc. Removes heat from cutting edges of tools and work. Feeds can be increased considerably, finer finishes and accuracy are obtained. TRICO-MIST absorbs heat, thereby quenching it faster than flood coolants which only transfer it. Chips slide freely up the tool face and are blown away automatically. Simple needle valve controls size and volume of mist spray. Attaches to shop air line. Available with one and five gallon containers—single or multiple outlets—single or dual valve control.

SEND FOR BULLETIN 37

TRICO FUSE MFG. CO.

For more data circle 500 on Postpaid Card

ed maximum of 18 inches in diameter.

Design features of the head include: adjustable depth of feed stops; a safety clutch which releases under overload; micrometer adjustment for radial tool positioning in increments of 0.0001 inch, and rigid tool slide

CERROTECHNICS SAMES TIME & MONEY in Anchoring Punches in Punch Plates



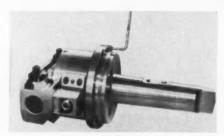
CERRROTECHNICS — the technology of using CERRO* ALLOYS to expedite industrial operations.

Guided by die plate, punches are located in oversize holes in punch plate. Cap screws inserted into punch bases through auxiliary plate hold punches while CERROMATRIX is poured. Cuts cost 50% to 90%. Send for full information.

CERRO SALES CORPORATION

Room 1501, 300 Park Ave., New York 22, N. Y.

For more data circle 501 on Postpaid Card



View of Davis CF-6E Precision Boring Head

clamping for heavy boring and turning operations. Three other models of Davis "CF" Heads provide bore ranges up to 10, 18 and 25 inches.

For more data circle 130 on Postpaid Card

* modern machine shop *

TOOL GRINDER

Hermes Machine Tool Co., Inc., 48-15 Northern Blvd., Long Island City 1, N. Y., is now distributing a universal grinding machine and tool grinding machine which is ideally suitable as a multiple machine especially for smaller production shops. The machine is suitable for external cylindrical grinding, internal cylindrical grinding, surface grinding with horizontal spindle, surface grinding with vertical spindle and for grinding all sorts of different tools and milling cutters.

Like all Blohm Grinding Machines, the table is provided with ball guide



ROTARY BUSHINGS

FOR DRILLING, CORE DRILLING ROUGH AND FINISHED BORING

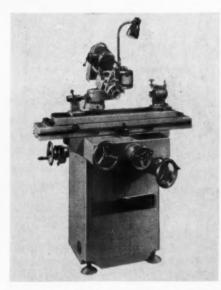
The inner race of the GATCO bushing rotates with the tool, piloting the tool accurately below or above the work - or both.

Eliminates expensive tool construction - Reduces tool wear - Prevents seizure and pilot breakage-Especially adapted where precision is required. Wite for full information and prices

ROTARY BUSHINGS

42336 ANN ARBOR ROAD PLYMOUTH, MICH.
Telephone Glenview 3-2295

For more data circle 502 on Postpaid Card



View shows Blohm Universal Tool Grinder

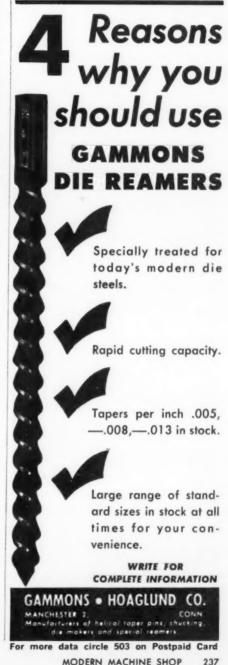
ways and therefore moves so lightly that it can be easily operated by hand during tool grinding. For surface grinding, external and internal cylindrical grinding the table is operated by means of a hand wheel between adjustable stops. The cross traverse mechanism deserves special mention as it is said to allow an infeed of 50 millionths of an inch and which is used for external and internal grinding. The clamping area of the table for surface grinding is 8 by 16 inches and the capacity for external grinding and tool grinding is 9/17 inch swing over the table by 27 inches between centers.

For more data circle 131 on Postpaid Card

★ modern machine shop ★

DOUBLE STOCK REEL

Durant Tool Co., 17 Thurbers Ave., Providence 5, R. I., has introduced an automatic double stock reel, with a maximum weight capacity of 1500 pounds each side. The self-centralizing



double reel is said to increase productivity by allowing simultaneous stock loading on one side and unwinding on the other

A heavy ball bearing turn table makes possible easy indexing of the reel and a simple locking device securely holds the coil in position for operation. Rugged band brakes, easily



View of Durant Automatic Double Stock Reel

adjustable, prevent over-travel of the coil while in operation. Rugged band brakes, easily adjustable, prevent over-travel of the coil while in operation. The stock reel is available in four sizes with maximum width capacities of 16, 24, 32 and 36 inches.

For more data circle 132 on Postpaid Card

modern machine shop *

METHOD FOR APPLYING HIGH HEAT-RESISTANT BONDING AGENT

Laminated Shim Co., Inc., 3308 Union St., Glenbrook, Conn., has developed a method for applying high temperature metallic edge-bonding material for producing "Lamisol," shims with easily removable layers of stainless steel. According to the com-



HAUSER Die Handler

For tool rooms, inspection, press and tryout departments.

Mobile or stationary. 180 degrees rotation of punch. Locks in any position. $24^{\prime\prime\prime}$ x $40^{\prime\prime\prime}$ base table. Ball bearing construction.

Dealer inquiries invited.

WRITE FOR DETAILS

HAUSER MFG. CO. 234 MILL STREET

For more data circle 505 on Postpaid Card

pany, the bonding material will withstand the high pressure and high temperature (up to 1100 degrees F.) conditions prevailing in spacecraft

applications.

The bonding agent does not in any way affect the peelability feature which is an important characteristic of standard "Laminum" as well as "Lamisol" shims. The company custom-produces laminated shims with layers of 0.002 inch or 0.003 inch for aluminum, brass, mild steel and stain-

less, and layers of 0.003 inch for titanium.

For more data circle 133 on Postpaid Card

* mms

DRY-FILM LUBRICANT

An improved bonded dry-film lubricant for cutting tools has been announced by The Alpha-Molykote Corp., 65 Harvard Ave., Stamford, Conn. Known as Molvkote PVE-K250. the coating can be applied to any clean metal surface. The compound is a single package coating which requires no mixing before application.

M o l y k o t e PVE-K250 is said to lengthen the life of such tools as gear cutters, reamers and taps by preventing metal pick-up or build-up on cutting tool flanks. It is easily applied by spraying and requires no surface preparation other than cleaning. As Molykote PVE-K250 is non-inflammable, no spray booth is necessary.

After tools have been evenly sprayed with a thin coat of Molykote PVE-K250 and allowed to dry in air for 30 minutes, the coating is cured for 1 hour in an oven heated to 140 degrees F. The parts are ready to use after cooling.

For more data circle 134 on Postpaid Card





reamer being

Taper

around

- permits TRUE work alignment from tailstock or headstock on: cylindrical grinders, cutter grinders, gear shavers, lathes and tracer attachments.
- · Saves one half the set-up time.
- Ends hit or miss table adjustments to obtain precise alignment.
- An inexperienced operator can get a precise alignment—easily—in seconds.
- Quickly pays for itself in time and scrap savings

	savings			
	Morse Taper	Brown & Sharpe	Jarno	
	#2 \$49.50		#6, #7 \$53.00	
11 1 1111	#3 61.50	#8,#9 65.00	#8, #9 65.00	
elical milling cutter	#4 76.00	#10, #11 85.00	#10, #11, #12 85.00	

Write for catalog and nearest distributor.

We also manufacture Precision Lathe Turrets and Tiny-Titan Magnetic Base Holders.

MANUFACTURING CO. Dept. 1101 4520 W. Fullerton Ave. Chicago 39, III.

For more data circle 506 on Postpaid Card

THREAD ROLLING HEAD

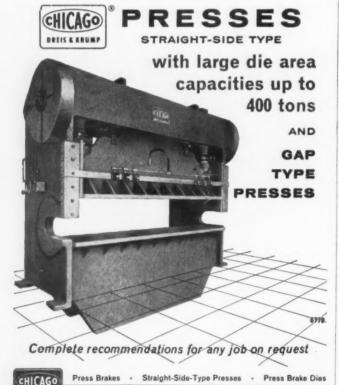
A 2 inch thread rolling head has been designed by Landis Machine Co., Waynesboro, Pa., to thread roll diameters from 1½ inch to 2 inches UNF and UNC (right and left hand). The No. 16 head, available in both stationary and revolving models, increases the Landis line of thread rolling heads to five sizes covering a

diametrical range from ½ inch to 2 inches. As with the other three sizes of heads, the revolving model is for application to threading machines and automatic screw machines using a revolving tool while the stationary head is designed for turret lathes, hand screw and automatic screw machines using a stationary tool.

Both styles are self-opening in operation. The stationary head is open by interrupting the forward travel of the turret or carriage, while the revolving

head is opened by interrupting the forward travel of the yoke. Closing of the stationary head is by a reset handle, while the revolving head is closed by a yoke.

In operation, the use of lead screw, cam or positive feed with these heads is not recommended. The necessary leading action is developed by the thread rolls mounted on roll shafts inclined to the proper helix angle. The roll shafts are inclined through re-





Hand and Power Bending Brakes . Special Metal-Forming Machines

7418 South Loomis Boulevard, Chicago 36, Illinois
For more data circle 507 on Postpaid Card



Landis 2 Inch No. 16 Thread Rolling Head

placeable helix angle bushings. For economy of operation, one set of bushings, having a "mean" angle, serves to roll all threads within the full UNC and UNF range of the head. Bushings having the "exact" helix angle can be substituted when extremely high precision threads are required. The same head can be used for right or left hand threads simply by using left and right hand bushing sets. An important benefit of the replaceable helix angle bushing feature is that heads may be recondi-

tioned after prolonged service without replacing major head component parts.

Changes in diameter and/or pitch are effected by installing the proper thread rolls. Size adjustment can be accomplished by means of two opposite set screws in the adjusting ring. For more data circle 135 on Postpaid Card

SHEAR WITH

m m s

AUTOMATIC FEED

Cincinnati Shaper Co., Cincinnati 11. Ohio. has introduced the Series 6216 Cincinnati Shear equipped with automatic handling devices which is said to simplify the cutting of 1/2 inch by 16 foot long steel plates. The front

conveyors include a storage area and centering unit in addition to a lower feed table and overhead feeding arms. Steel plates to a maximum of 1/2 inch thickness, 8 feet in width and 16 feet in length are delivered to the feed area by an overhead crane. As the material is fed through the shear, required blank widths are measured with power operated back gauge.

Sheared pieces are discharged at the rear of the machine by means of a rear conveyor and scrap separating device. Floor mounted controls inter-



For more data circle 508 on Postpaid Card

Dept. 701, 1133 Rankin Street, St. Paul 16, Minn.

Grind Accurate Free Cutting Drills

1/8" to 21/2" dia.
90° to 140° included angle with
Variable Clearance
NO CHUCKS
NO COLLETS
True Conical
Relief for FAST CUTTING

STERLING "DV" Drill Grinder

Positive setting for included angle and clearance angle plus accurate centering produce the right point for every material. For details and prices write for Bulletin "DV" TODAY.

McDONOUGH MFG. CO.

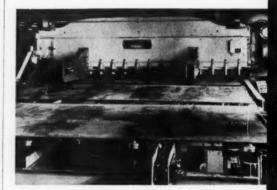
1521 Galloway, Eau Claire, Wisconsin

For more data circle 509 on Postpaid Card



For more data circle 510 on Postpaid Card

new equipment . . .



View shows Cincinnati Series 6216 Shear equipped with automatic handling devices

lock the machine cycle with the front and rear conveyor equipment for safe and convenient operation. Other features incorporated in this Cincinnati Shear include hydraulic holddowns, ball transfers in the table, 48 inch back gauge range, power operated, and automatic pressure lubrication.

For more data circle 136 on Postpaid Card

★ modern machine shop ★

CARBIDE BUSHINGS

Carbide bushings are now available along with other bushing products manufactured by Ex-Cell-O Corp.,



View of Ex-Cell-O Tungsten Carbide Bushings

1200 Oakman Blvd., Detroit, Mich. The complete bushing line includes Ex-Cell-O and A.S.A. Standards and Thin-Walls; Trans-Lok and Press-Lok with serrated o.d.'s for use with plastics and ductile materials, and the new carbides

Tungsten carbide bushings are said to be more economical in many applications because of decreased machinery down time for changing bushings on high production runs. Also, in cases where bushings are subject to extreme

wear, such as in drilling angular holes, carbide bushings can give accurate hole location over a longer period of time with the added advantage of longer drill life. For more data circle 137 on Postpaid Card

m m s

SURFACE GAGE

The Magic City Mach. & Tool Co., 817 East Charles St., Muncie, Ind., has added to its line of parallels and diamond holders a surface gage



View of Magic City Surface Gage

called the Hi-Dicator. The tool has a heavy chrome plated and lapped base (lacking that top heavy feeling), with double bar chrome plated elevation standards, insuring extreme rigidity. with no-back-lash, instant locking indicator holding assembly, which is said to make split tenths adjustment easier.

Primarily a comparison surface gage, extremely accurate measurements may be made using gage block or inside micrometer insertions.

For more data circle 138 on Postpaid Card





for low-cost figs and fixtures.

SEE YOUR INDUSTRIAL SUPPLY DISTRIBUTOR OR ORDER DIRECT, GIVING DISTRIBUTOR'S NAME

Adjusto-Quick JIG-LOI

Simplifies jig and fixture design. Pressure adjustment, 1 to 1500 lbs. Easy hand pressure securely holds work without distortion. One inch of the hardened lacking bar is soft for easy machining. 4" x 4" base, \$20.00, 5" x 5", \$25.00

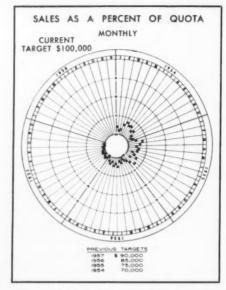
28 S. ST. CLAIR ST. · TOLEDO 4, O.

For more data circle 511 on Postpaid Card

VISUAL AID CHART

Compton Chart Productions, 239 East First Ave., Roselle, N. J., has announced the availability of a line of target charts for graphically plotting data which is goal-directed. This concept in graphic presentation is ideally suited for plotting sales per-





Drawing of the Compton Target Chart for graphically plotting data which is goal directed

BURR KEYSEATERS

Mill keyways in the run or on the ends of sharting already erected—save money on alteration, erecting, and repair work.

ALSO Planer-type MILLER up to 144" table length. Write for Bulletins and prices.

185 26th St.

John T. Burr & Son, Inc. Brooklyn 32, N. Y.

For more data circle 513 on Postpaid Card

formances, production quotas, financial figures and an infinite number of other quantitative data, showing clearly how closely the data approaches the goal or innermost circle.

Compton Target Charts are designed to permit the plotting of data weekly, monthly, quarterly, annually or by other suitable time periods. If desired, these charts can be used perpetually, offering a constantly current and historical portrayal of data. The target charts are said to be



23-16 44th ROAD

CAMS

Complete Facilities For

CAM MILLING & CAM GRINDING

To Your Specifications

DIVISION OF HIMOFF MACHINE CO.



LONG ISLAND CITY, N. Y.

For more data circle 514 on Postpaid Card

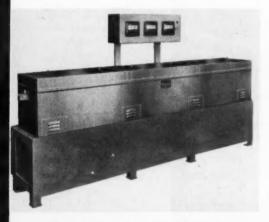
easy to read, time saving, dramatic and illustrate at a glance the comparative relationship of all data plotted. Compton Target Charts are available in pads of 25 sheets printed on 81/2 by 81/2 inch stock, or in pads of 10 sheets printed on 16 by 16 inch stock which can be glazed, mounted or framed upon request. Variations of the basic chart can be designed to suit individual specifications.

For more data circle 139 on Postpaid Card

modern machine shop *

CONVEYORIZED SOLDERING FURNACE

A conveyorized soldering furnace has been announced by K. H. Huppert Co., Dept. MO-3, 6840 Cottage Grove Ave., Chicago 37, Ill., which is said to be suitable for a wide variety of highvolume soldering. While it proves especially adaptable for automatic soldering of small electrical and electronic components, it can also be used in almost any manufacturing operation requiring high quality, uniform soldered connections. The Huppert Conveyorized Soldering Furnace has three overlapping zones of tempera-



Huppert Conveyorized Soldering Furnace

Make mark with a HOGGS time-tested STEEL

Hoggson stamps are made of finest alloy steel, heat treated to stand continuous impact without breakage of face or mushrooming of body. Available for marking letters, figures or symbols on almost any metal, plastic, or wooden product. Any style letter or figure in face sizes from 1/32" to 1/2".

Write us for information, or see your nearest mill supply.

HOGGSON & PETTIS MFG. CO.,

New Haven 7, Conn. For more data circle 515 on Postpaid Card

MODERN MACHINE SHOP

ture control for a total accurate heating length of nine feet. Heating elements are made of ¼-inch Kanthal rod for long, dependable service. Special alloy conveyor rails provide full support for the conveyor load through the furnace. The entire soldering unit is encased in stainless steel with a three-section removable top for ease of inspection and maintenance. Power

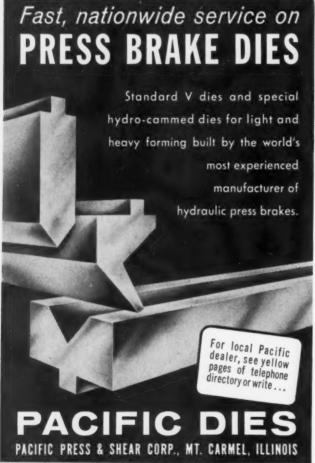
transformers, contactors and other electricals are mounted in the base of the furnace and the large instrument control panel is centrally located at the top for easy viewing. Huppert Furnaces are completely shop-assembled, wired and tested before shipment. To put the furnace into operation, all that is required is a connection from the main plant power supply to the fused disconnect switch. The company states that the basic design and construction of the con-

veyorized soldering furnace lends itself to various laboratory and production requirements.

For more data circle 140 on Postpaid Card

* mms *
CHIP BREAKERS

A design change which enables chip breakers to be offered as standard components on several sizes of its screw-on cartridges has been announced by the Microbore Div., DeVlieg Machine Co., Fair St., Royal Oak, Mich. The chip breakers are now provided with the company's size 5, 7 and 10 screw-on type cartridges for general purpose boring operations with carbide cutting tool inserts.



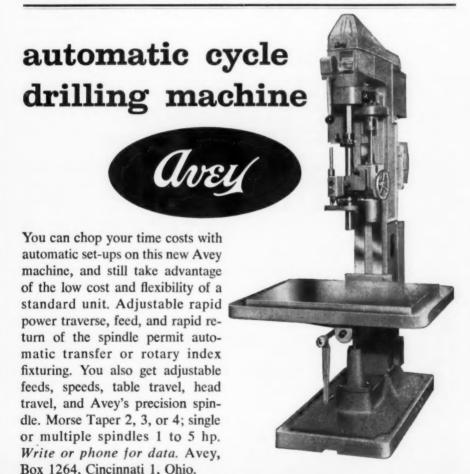
For more data circle 516 on Postpaid Card

The design modification, which increased the shoulder height of the insert pocket in each of the cartridge sizes involved, according to the company, led to the inclusion of the chip breaker as a standard component. The change provides a natural backup support for the chip breaker on each of the cartridges. The chip breakers may be used on similar cartridges now in service—only if the shoulder height of the insert pocket extends above the carbide insert currently employed.

For more data circle 141 on Postpaid Card

DECIMAL WIDTH MILLING CUTTERS

A complete line of high speed steel decimal width milling cutters in any width by 0.001 inch has been made available on a 24 hour delivery basis by QT Tool Co., 1000 R St., Bedford, Ind. Called "Deci-Mills," the cutters are manufactured in widths from 0.015 to 1.025 inch by 0.001 inch. Shank style Deci-Mills are made in ½ to 1½ inch diameters, and arbor style in 3





For more data circle 518 on Postpaid Card

Production CHUCK

Will pay for itself in 60 to 90 days

On turtets, engine lathes, cuttingoff machines, drill presses or any
type of chucking machine, the
Barker Two-Jaw or Three-Jaw
hand operated chuck will increase
production up to one third and
actually pay for itself while
doing it in from 60 to 90 days.
Hand lever eliminates pneumatic and hydraulic systems, yet closes and locks
jaws with lathe running
or stopped. Over 30



Jaws locks

Write for bulletin 201 today.

THOMAS HOIST CO.

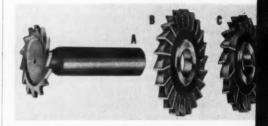
years of labor saving,

production boost-

ing operation.

For more data circle 519 on Postpaid Card

new equipment . . .



View shows QT "Deci-Mills": (A) narrow width Woodruff style cutter, (B) side milling cutter and (C) stagger tooth side milling cutter

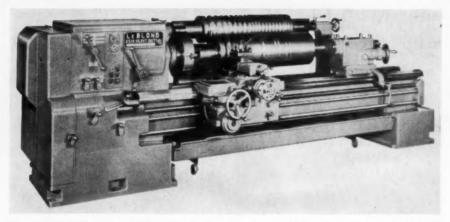
and 4 inch diameters. Arbor cutters are available in two types—side milling and stagger tooth side milling. For more data circle 142 on Postpaid Card

* modern machine shop *

HEAVY DUTY LATHES

The R. K. LeBlond Machine Tool Co., Cincinnati 8, Ohio, has announced the redesign of its NF Design Heavy Duty Lathes. Said to be outstanding performers in the 40 h.p. class, the 2516 and 3220 size lathes have the most wanted features for heavy-duty service. Bed widths, especially, are indicative of the heavy duty ruggedness of the lathes. The 2516 (25-inch swing over bed, 16-inch swing over cross slide) has a 22¾-inch wide bed and the 3220 has a 24½-inch bed.

Extreme rigidity and high power suit these lathes equally well to hogging cuts and ultra-smooth finishing. They can be used both for turning heavy forgings and delicate toolroom work on precision missile components. Lathes in these sizes are popular in ordnance and heavy machinery shops. Fitted with LeBlond's 90-degree Tracer, they are ideal for turning bar mill and similar steel mill forming rolls. Both the NF 2516 and NF 3220 have 36 spindle speeds, in three ranges



View shows LeBlond 2516 NF Design Heavy Duty Lathe which has a 223/4 inch wide bed

from 10 to 1,300 r.p.m. They offer 60 feed and thread changes with standard feeds ranging from 0.0045 inch to 0.269 inch. Both lathes are rated for 40 h.p. motors.

Spindle speeds are selected through

an all-spur-gear drive which operates according to LeBlond's exclusive noload principle in which only gears and shafts transmitting power are in motion, providing lowest possible power loss and maximum efficiency.



For more data circle 520 on Postpaid Card



PUNCH PRESS FEEDS

RAPIDAIR
Speeds your production

Speeds your production Compact—Fast—Accurate!



Rapid-Air press feeds are self-contained air operated, high speed units for feeding coil stock up to 6" wide. Easy to set up, unit mounts on die set or bolster. Write for bulletin.

MECHANICAL TOOL & ENGINEERING CO. 2323 TWENTY-THIRD AVENUE, ROCKFORD, ILLINOIS

For more data circle 522 on Postpaid Card

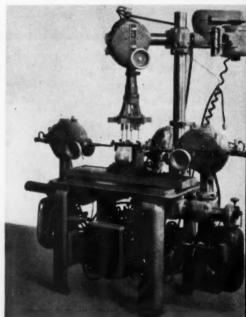
The bed ways are hardened and ground, and replaceable. Both lathes may be obtained in toolroom models. The 2516 NF is built in a plain bed gap model, which is said to increase the swing approximately 50 per cent through the gap.

For more data circle 143 on Postpaid Card

* modern machine shop *

MULTI-HEADED DRILL

A multi-spindle machine has been introduced by Van Norman Machine Co., 3640 Main St., Springfield 17, Mass., which the company states can simultaneously drill, counterbore, tap and ream a workpiece from almost any angle. The "Versi-Matic Drill" has heads that revolve 360 degrees



View shows Van Norman Versi-Matic Drill

both horizontally and vertically either on or under the work table. Equivalent in size and power to a conventional 17 to 20 inch drill press, it performs as a special purpose machine for continuous runs. Yet it can readily be rearranged to meet the requirements of other jobs.

Each head is individually powered and can be operated by automatic power or manual feed. Meeting any job requirement, spindles operate in

sequence as well as simultaneously. The Versi-Matic will accept all standard drill attachments. For more data circle

144 on Postpaid Card

★ mms ★

MINIATURE PARTS HEADER

REM Sales Inc., West Hartford. Conn., has announced an improved Model "00" Solid Die Double Stroke Cold Header for miniature parts. The major design change consists of a variable speed drive arrangement allowing instantaneous speed adjustment while the machine is in operation. By simply turning a hand dial fly wheel speed can be adjusted between 150 and 300 r.p. m., thus permitting the operator to gradually

"tune in" to maximum practical operating speed after a job is setup.

The cold header is built into a desktype cabinet base having tool storage drawers and work receiving pans. The motor drive is housed in the cabinet, supported by a metal framework. The machine is provided with a one-shot lubricating system, and operates smoothly.

Having wire diameter capacity from 0.012 inch to 0.070 inch, the cold



NEW "BUILDING BLOCK" UNITS for ULTRASONIC MACHINING

Sheffield-Cavitron® offers a complete line of ultrasonic generators, work heads, tooling, work-holding devices and automatic loading and cycle controls. You can begin with a single unit, as simple as the one shown, (which dices small lots of semi-conductors) and work stations can be added as needed, to the original generator, with greatest economy . . . Write for bulletin H7-59 "Machining the Unmachinable."

The SHEFFIELD Corporation • Dayton 1, Ohio

A subsidiary of The Bendix Corporation
For more data circle 523 on Postpaid Card

header was developed particularly for the manufacture of tiny components such as electrical contacts, optical screw blanks, and other miniature rivet forms. A special die block and mechanism included with the standard equipment allows deep hollowing of rivet shanks in soft materials such as



Low Price—\$149.50 Includes Diamond

NEW 1961 MODEL "SS" RADIUS DRESSER Newly engineered and

redesigned after 19 years of field testing. Convex, concave, or complex combination shapes are dressed quickly and easily by even inexperienced operators. Accuracy to .0002". Dresses all wheels up to 12" diameter.

Write today for free illustrated folder.

SOMERSET TOOL CO. 320 Virginia St. Hillside, N. J.

For more data circle 524 on Postpaid Card



For more data circle 525 on Postpaid Card



Morris-Omega Model "00" Solid Die Double Stroke Cold Header with variable speed drive

aluminum and fine silver, although the machine is not claimed to be a tubular rivet header. A single stroke model for heading balls up to 0.0625 inch finished size is also available.

For more data circle 145 on Postpaid Card

* modern machine shop *

FOUR MOTION ABRASIVE FINISHING PROCESS

An approach to abrasive finishing for hardened gears and cylindrical parts, embodying a four-directional relative movement between the work-



SPELLMACO "SPOTTERS"

A matched set of transfer punches for toolmakers, machinists and tool cribs

Used for transferring location of threaded, drilled and reamed holes, slugs, blanks, etc.

Precision made of finest tool steel—Carefully heat treated and tempered for long life—.0025 undersize to facilitate use—Black oxide finish.

SET #3-17; 28 punches with indexed stand—sizes $\frac{1}{32}$ " to $\frac{1}{2}$ ", by $\frac{1}{44}$ "—plus handy $\frac{17}{32}$ " size. Length $\frac{4}{8}$ ". ONLY \$19.40.

R. L. SPELLMAN CO. . URBANA, OHIO

For more data circle 526 on Postpaid Card

piece and the abrasive tool, has been announced by Michigan Tool Company, 7171 E. McNichols Rd., Detroit, Mich. The process enables better surface finishing of gears and other parts after hardening. Along with the process, new and improved abrasive tools ranging from extremely fine to coarse grits for extremely fine finishes or rapid finishing have been developed. With the process, nicks and burrs can be removed with ease and some dimen-

sional errors in lead and runout. involute, and so on, can be corrected in a minimum of finishing time since the process does not have to depend solely on relative rotary motion between the tool and the workpiece. The process provides smoother and quieter running of parts such as gears without the necessity of matching or lapping.

The process has been incorporated in a new version of the Michigan Abrasive Gear Finisher. It is available as standard on the new 999-A machines. In addition, a headmodification kit is available to convert former models of Michigan Abrasive Gear Finishers to

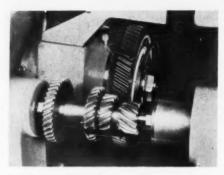
the new process in the field. For finishing gears, the abrasive hone used is a gear-like tool made of special high strength plastic impregnated with abrasive. It is rotated in tight mesh with the hardened work gear at crossed axis. The honing action on the gear teeth is achieved by combining four motions—an in-mesh rotation under controlled load; a crossed axis relationship between hone and work; a high speed axial oscillation of the tool in a



ratio of 3 oscillations per 1 revolution of the tool and a reciprocating motion which traverses the work a preset amount across the hone for the gear's full face width.

In addition to finer finish, the "Four-Motion" movement is said to result in faster processing and longer tool life. Hone rotation is variable from 150 to 600 r.p.m. and table reciprocation can be independently varied thus allowing high spindle speed and slow table reciprocation or vice versa. The tool head angle is variable up to 25 degrees. Axial movement of the hone is approximately 1/16 inch and is fixed at a ratio of 3:1 with the r.p.m.

The 999-A machine is easily adaptable to full automation or to automatic loading. Manual loading is very simple due to minimum distance from machine front to centers. Optional equipment includes automatic loading



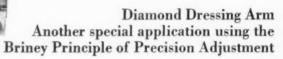
The four motions of the new gear finishing process impart a true honing action. Arrows show three of the separate motions and fourth motion is created by crossed axis relationship between hone and workpiece.

device, crowning-taper attachment, internal gear finishing head and manual or automatic tool dresser. The Model 999-A Abrasive Hard Gear Finisher will handle a wide variety of gears up to 12 inches in diameter. For more data circle 146 on Postpaid Card

BRINEY invites your inquiry-

for precision tools requiring split-tenth adjustments without loosening or tightening screws

Precision Boring and Turning Tools Stocked standards and specials



and Anti-Friction Support and Pilot Bearings Stocked standards and specials

SEND FOR COMPLETE BRINEY TOOL LITERATURE TODAY

BRINEY MFG. CO.

P.O. Box 208 Pontiac, Michigan Phone: FEderal 4-2552

For more data circle 528 on Postpaid Card

CUT-OFF MACHINE

Stone Machinery Co., 11 Fayette St., Manlius, N. Y., has announced the addition of a heavy duty, highspeed metal cut-off machine to its present line. Designated the M-160, the rugged 15 h.p. machine, the company states, will handle a wide range of ferrous and non-ferrous cutting operations with accuracy, speed and safety. The Model M-160 is powered by a full 15 h.p. continuous duty, geared-in-head, T.E.F.C. ball bearing induction type motor, 220/60/3 or 440/60/3, with load ammeter, overheating indicators, and No. 2 magnetic starter. The geared-in-head feature is designed to produce greatest efficiency of power from motor to spindle.

Available in either 20 or 24 inch size, with stationary type wheel guard for maximum operator safety, the M-160 may be equipped for wet or dry cutting, as well as manual, semi-automatic or fully-automatic operation. A fast acting, self-centering vise with adjustable jaws clamps work close to



View of Stone Model M-160 Cut-Off Machine

PRODUCTION MEN! CAN YOU APPLY

YOU CAN WITH CMD EXTREME-PRESSURE

HERE IS A MOST REMARKABLE LUBRI-CANT for lathe centers, steady rests, thrust bearings, broaching, swaging, tappingany operation where you must eliminate metal-to-metal contact!

LABORATORY TESTS PROVE CMD to be the only lubricant to withstand EXTREME pressures.

Read how big industry has solved reject problems, longer runs at savings up to 81% over commonly used Jubricants Free booklet of testimonials, new uses, new lubricating facts. Write:





CHICAGO MANUFACTURING & DISTRIBUTING COMPANY

1928 W. 46th St. . Suite S-10 . Chicago 9 For more data circle 529 on Postpaid Card

MODERN MACHINE SHOP

255

cutting edge regardless of angle. The vise, mounted on a heavy cast smooth surfaced table, is machined for jigs and fixtures and is adjustable for angular cutting to 46 degrees. Positive and rigid holding is said to assure utmost operator safety and greatest wheel life efficiency.

For more data circle 147 on Postpaid Card



For more data circle 530 on Postpaid Card



TOOLING SYSTEM

Guaranteed repetitive accuracy in millionths that is unimpaired by wear is the salient feature of a tooling system, "Micro-Magic" which has been announced by the Wadell Equipment Co., Clark 2, N. J. It is intended for use on precision boring machines, jig borers, and any other machine where quick changing of tools for high precision, multiple operations is desirable or necessary. An additional feature of the tool is that it combines quick changing and positive fine adjustment in one single tool. For example, if one had to rough bore, finish bore, and counterbore, the tooling requirements would be one complete unit and two top plates.

The complete unit containing a top plate with boring bar for the roughing operation is mounted on the spindle nose. The boring bar is adjusted to the desired cutting diameter and the dial reading on the tool periphery is recorded. After the roughing operation the top plate with roughing tool is removed and a second top plate with boring bar for the finishing operation is mounted on the unit. The boring bar is adjusted for the finish diameter and dial reading recorded. The top plate is removed and another top plate containing the counterboring tool is mounted on the unit and the dial reading again recorded. Thereafter these three top plates can be



FASTER set-ups and positioning

You save set-up and positioning time with Gilbert rotary tables. *Hand-indexing*: 36" and 50" square or round. *Power rotary* and *power feed*: 36", 50", 60", and 72" square or round. Special tables built to your requirements. For complete descriptions and specifications, write for Bulletin 854.

THE CINCINNATI GILBERT MACHINE TOOL COMPANY . CINCINNATI 23, OHIO

For more data circle 532 on Postpaid Card



Wadell "Micro-Magic" Tooling System

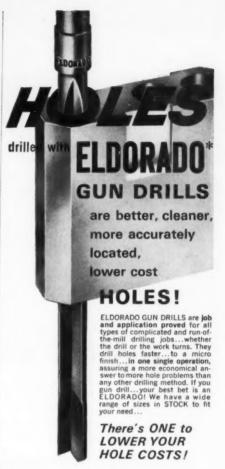
removed and reinstalled repetitively to within a few millionths of their original setting. After the first part is finished, repetitive parts can be identically finished—subject only to the tolerance limitations of the machine itself. In short, the fact that you are changing tools is not a factor in maintaining accuracy. "Micro-Magic" tools can be furnished in any size and style for every spindle application as well as complete tooling systems including boring bars, and so on.

For more data circle 148 on Postpaid Card

* modern machine shop *

SCRIBED STEEL CUBE FOR AUTO-COLLIMATOR

Engis Equipment Co., 431 S. Dearborn St., Chicago 5, Ill., has announced one of the most accurate tools devised for use with auto-collimating instruments is the steel cube: and the scribed cube, with perfectly centered and squared locating cross, is among the latest in the family of reflecting accessories, which includes also mirrors and precision polygons of both steel and glass. The cube, which may be used mounted in a special holder or located directly for periodic checks, is required wherever angles have to be determined by auto-collimation together with precise lateral position. It is therefore designed for use with autocollimating Theodolites and other focusing auto-collimators, or align-



ELDORADO'S specialized Engineers and research facilities are available to assist you in the selection of the right gun drill tool or drilling method to solve special hole drilling problems.

ORDER OR WRITE TODAY

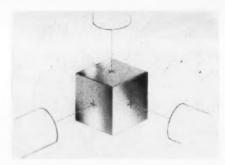
	AVAILABLE FROM ALL SOLID CARBONE TIPI inc. in every 1/84" incre	
Size-Dio.	LENSTH	Brings
.5600° tu	18", 18", 22"—all dies. 28", 38"—most dies.	W" x 296"
1188" to .7580"	10", 22", 30"	1"12%"
855" to	22", 36"	1%"12%"
-	MMEDIATE SHIPMEN	

ELDORADO TOOL & mfg. corp

364 BOSTON POST ROAD • MILFORD, CONN. For more data circle 533 on Postpaid Card

ment telescopes equipped for autocollimation.

The cube is available with any number of polished faces, from two to six. These faces, whether parallel or perpendicular to the base are made accurate one to the other from 0.5 seconds of arc to 3.0 seconds of arc. The cross lines on the scribed model are cen-



Steel Cube an accessory for Auto-Collimators

Accurate Hole Transfer Made Easy With **NIELSEN TRANSFER SCREWS**

Simply insert in holes, invert, strike sharply and you have centers and drill circles perfectly located. Reduce time and eliminate spoilage of other methods. 8 sizes, from 1/4" to 1/4" U. S. S. Inexpensive-Last

for years. Write for Circular NIELSEN TOOL & DIE COMPANY 17336 Lahser Road

Near Grand River Detroit 19, Michigan

For more data circle 534 on Postpaid Card

tered to within an accuracy of 0.0002 inch. The cube is made of hardened and tempered steel, stabilized by heating, followed by slow cooling process. It easily lends itself to calibration; with an interferometer its accuracy can be checked to 0.250 seconds.

For more data circle 149 on Postpaid Card modern machine shop *

ACCURATE SET-UPS FAST



Accurate, rapid set-ups the first time, every time . . . is the reason Brookfield Tool Holders are now widely used in practically every metalworking plant in the country. With one Brookfield Tool Holder, you can cut your stock of bushings by at least 100. Here's why:

SOLENOID

A single purpose solenoid, designed especially for hydraulic and pneumatic valve applications, has been announced by the National Acme Co., Electrical Controls Div., 183 East 131st St.. Cleveland, Ohio.

The "T" type solenoid is available in four sizes with a push range of two to twelve pounds with up to a half inch stroke. It can be obtained with or without a captive or loose push pin of

BROOKFIELD TOOL HOLDERS

ADJUSTABLE V JAW holds wide range of tool dia eters without bushings or acces-

AXIALLY TRUE DESIGN makes perfect tool alignment almost automatic.

BALANCED PRESSURE LOCKING ASSEMBLY ntains uniform seating, eliminates creep or shift.

EASY TO USE - just slip tool in the jaw, tighten, then float tool into dead center and lock.

AVAILABLE IN A WIDE RANGE OF SIZES MODEL

RANGE DIA. 14-14 BA-10 270 DA-10 16"-15" DA-12 14"-12" 14"-34" GA-12 350 GA-16 10 - No. KA.15 14"-1" KA-24 3/1-11 PA-24 16"-116" 1354 PA-28 14"-114" 1304

WRITE FOR ILLUSTRATED CATALOG AND PRICES!

BROOKFIELD, INCORPORATED

EMPIRE TOOL COMPANY, MEMPHIS, MICHIGAN LAIRD DE VOU, INC., CAMBRIDGE, MASS.

For more data circle 535 on Postpaid Card

JIG GRINDING and JIG BORING

to your specification

At your disposal. Our sub-contract jig boring department, one of the best equipped in the

A. K. TOOL CO., INC.

ROUTE 22, MOUNTAINSIDE, N. J. Telephone: ADoms 2-7300 Digby 9-1445, N Y C

For more data circle 536 on Postpaid Card

various lengths and diameters and either a standard bobbin or epoxy model core.

For more data circle 150 on Postpaid Card

* modern machine shop *

PORTABLE FEED FOR PRESSES

A "swing-out" portable feed which makes a press easily adaptable to either single or continuous operation has been introduced by the E. W. Bliss Co., Press Div., Hastings, Mich. Available on new presses only, it can be used as a conventional single roll feed for continuous feeding or by simply removing two bolts, it can be swung away from its normal position to permit single trip hand feeding.

Further versatility is afforded by the adaptability of one feed to a number of presses of the same or different tonnages. Each press must be equip-



Measures the exact BORE or blind hole size! Reading .0001" Size: 3/16" to 4"

Takes accurate measurements of blind holes. No master — measures directly—by .0001". Automatic alignment, rectangular contact points guarantee extreme accuracy even when fully extended. Immediately detects out of round holes; with extensions measures holes up to 30" deep. Hardened contact points exert minimum pressure — will not damage fragile work.

Easy to read, deep graduations on a large diameter thimble. Dull chrome plated. Furnished in English or Metric graduations, individually or in sets.

WRITE FOR CATALOG on complete line of precision measuring instruments: VERNIER CALIPERS, MICROMETERS, DIAL INDICATORS.



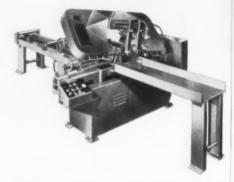
INA CORPORATION

122 East Second St., Mineola, L. I., N. Y.

For more data circle 537 on Postpaid Card

CO/

Production Sawing Accuracy



to \pm .003" length and .002" of depth of cut runout squareness

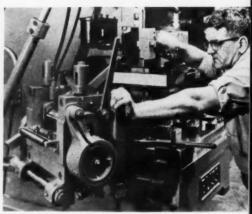
The Peerless Saw provides industry with a rugged production saw which has no peer in the field today. Not only does it provide a fully automatic operation at high production speed for sawing billets, bars and structural shapes, but the Peerless Model 1200 can be used selectively as a power pullup conveyor—all with a length accuracy to \pm .003".



PEERLESS MACHINE CO.
Oshkosh, Wisconsin
For more data circle 538 on Postpaid Card

260 MODERN MACHINE SHOP

new equipment . . .



Bliss "Swing-Out" Portable Feed for presses

ped with special mounting pads, pivot bracket, and throwblock to permit transfer of the feed from press to press. The feed can handle 0.125 inch stock up to 8 inches wide. It has a feed length of 0 to 8 inches and a feed height of 2 to $4\frac{1}{2}$ inches.

* modern machine shop *

ANGLE PLATE

An improved universal angle plate has been announced by Rahn Granite Surface Plate Co., 636 North Western Ave., Dayton 7, Ohio. The angle plate, made of diabase, is in the form of an "H" design. In addition to the usual advantages of diabase over cast iron, (extreme hardness, no humps caused by nicks, no rust, no warping, and so on) the "H" design offers a number of additional advantages. The face of the H-section provides more space for clamping an article. The clamps may be placed to the bottom. The "H" design has a relatively large weight opposite the face to which the article is clamped. This weight helps



View shows Rahn Universal "H" Angle Plate

to compensate for the weight of the article and eliminates the necessity of clamping the diabase "H" angle to a surface plate in most cases.

The symmetric design insures uniform wear on the base as it is moved about on a surface plate. Any tendency of the angle to wear obtuse due to the weight of the article clamped to a face, is corrected when the oppo-

site face is used. This practically eliminates the possibility of losing the accuracy of any of the twelve 90 degree angles. With two similar "H" section bases, which can be interchanged, the H-universal divides the wear of each base in half, thus doubling the precision life of the bases. With two similar faces, which can be used interchangeably, the H-universal divides the face wear in half, thus doubling the precision life of the faces. Placed on its side, it can be used as a pair of precision parallels.

The "H" section bases are large enough that it can be used as a riser. All opposite faces are precision parallel so that it can be used as a riser in any direction.

At present, the H-universal angles are made in two sizes, 6 by 6 by 6 inches and 6 by 9 by 6 inches. Each is made in two grades, Inspection grade and Laboratory grade, In the Laboratory grade, each of the twelve

Instant change cuts production costs

AUTOMATIC KEYLESS CHUCK permits tool changes in seconds without stopping the spindle; prevents chewed-up shanks. One spindle does the work of many. The greater the torque, the tighter the grip.

DRILL PRESS VISE floats, and locks instantly, positively, in any position on the table. Holds work safely for accurate drilling and tapping. Three models: 8", 9" and 12" capacities.

Write for illustrated folder and name of nearest distributor to AMF Tool Division, American Machine & Foundry Company, 224 Glenwood Ave., Bloomfield, N.J.



WAHLSTROM®

AUTOMATIC CHUCKS



FLOAT-LOCK

SAFETY VISES

For more data circle 539 on Postpaid Card

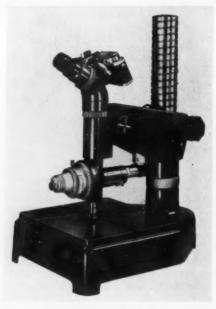
90 degree angles is made to a tolerance of 0.000025 inch, TIR over the entire faces and for Inspection grade, the tolerances are 0.000050 inch TIR. For more data circle 152 on Postpaid Card

* modern machine shop *

LIGHT WAVE SURFACE TESTER

An interference microscope for checking highly finished surfaces is being offered in the Leitz Light Wave Surface Tester by Opto-Metric Tools, Inc., 137 Varick St., New York 13, N. Y. As the name implies, the instrument determines the smoothness of surface finish interferometrically, without making actual contact with the surface under test.

The instrument employs the Michelson Beam Splitter method and measurement is in terms of light waves. A



View shows Leitz Light Wave Surface Tester



MONEY-BACK TRIAL OFFER Order a trial gallon of each today for testing in your shop. We'll cancel the bill if you're not satisfied.

PREVENTS HEAT TREAT SCALE... up to 1500°F. Brush on, heat, brush off. All metals.

cut weld cleaning time by 85%

Throw away your cold chisel and whisk off weld spatter with a dry rag! Protect-O-Metal spatter-proofing compounds make weld cleaning a breeze. Improve your welds at the same time . . . P-O-M compounds quiet the arc, improve fusion and electrode operation, prevent oxidation and annealing scale, cause no porosity. No smoke odors, or fumes.

P-O-M No. 2. Non-inflammable, non-toxic water-soluble paste. Inorganic. Thin before applying and start welding at once. \$3.40 per gallon, f.o.b. Dayton.

P-O-M No. 8. Rust- and corrosion-resistant resin base compound. Comes ready to use. Safe for all metals. Good paint primer; permits outdoor storage of subassemblies. \$3.45 per gallon, f.o.b. Dayton.

PROTECT-O-METAL

G. W. SMITH & SONS, INC.

1702 SPAULDING RD., DAYTON 3, OHIO

For more data circle 540 on Postpaid Card

choice of 3 interchangeable magnifications of 100x, 200x and 500x is standard equipment.

For more data circle 153 on Postpaid Card

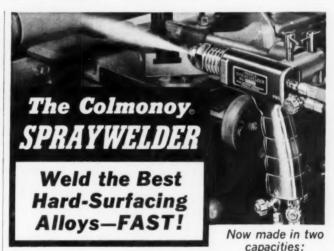
★ modern machine shop ★

TORQUE-TESTING AND SETTING GAGE

A precision torque-setting gage which can be used for testing nut runners and screw drivers

under power. assures uniformity of tightness in assembly. The portable tester. manufactured by Scully-Jones and Company, 1909 South Rockwell St., Chicago 8, Ill., is said to measure torquerelease limits with a repeatability of plus or minus 3 percent. For hand or powertools utilizing torquelimiting clutches, the tester provides a convenient, quick method rechecking tools on the job. It is designed to meet the needs of accurate assembly in instrument, missile, and aircraft plants where it is desirable to maintain uniform tightness in fastening operations which require the use of numerous tools.

To measure torque, the worker simply applies the power tool to the input shaft of the tester, just as though the worker was driving a screw. The precision-dial pointer indicates the exact number of in.-lb, of torque at which the drive releases. A reset-type indicator and large dial calibrations simplify accurate reading of torque at points of tool release, facilitating exact setting of the power tool, as needed. Scully-Jones dynamic torque-tester measures 4 by 4 by 7 inches and can



Spray on hard-surfacing alloys that fuse into long-wearing welded overlays. The Colmonoy Spraywelder applies highest quality nickel and cobalt base Colmonoy hard-surfacing alloys (eight grades). They produce abrasion and corrosion defying overlays that are uniform and readily finished.

The Spraywelder applies metallizing coatings too. Use Colmonoy C-290 Powder(to rebuild crankshaft bearings) and other common metal powders.

MODEL D

MODEL D

High capacity of over 12 pounds per hour, at up to 95% efficiency.

MODEL F

Medium capacity of 7½ pounds per hour, at over 90% efficiency.

Ask for the Spraywelder Catalog

HARD-SURFACING

WALL COLMONOY

A BRAZING ALLOYS 19345 JOHN R STREET . DETROIT 3, MICHIGAN

Buffalo • Chicago • Houston • Los Angeles • Morrisville • New York • Pittsburgh • Montreal • London, England
For more data circle 541 on Postpaid Card



BALCRANK

MAKES THE BEST!

HAND WHEELS

Best quality, fine grain cast iron.
Rim and handles polished. Handles revolving, solid or omitted.
Sizes 4" to 12" dia. with other machining to specification.





MACHINE HANDLES

Handles turn on HARDENED steel spindle, permanent graphite grease lubrication for FASTER, EASIER adjustment. Quality BAR STEEL ground and POLISHED.









WRITE FOR FREE CATALOG AND PRICE LISTS TODAY!

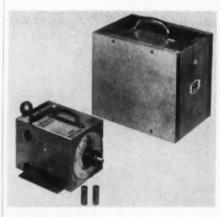
Machine Tool BALCRANKING. Division BALCRANKING. 18 DISNEY ST. • CINCINNATI 9, OHIO, • U. S. A.

For more data circle 542 on Postpaid Card



For more data circle 543 on Postpaid Card

new equipment . . .



View of Scully-Jones Portable Torque Tester

be mounted either vertically or horizontally on a workbench or wall. The tester is available in two torque ranges -0.30 in.-lb. and 0.60 in.-lb. The tester comes in a sturdy wood case with two $\frac{1}{4}$ inch socket adapters. For more data circle 154 on Postpaid Card

* modern machine shop *

BAND SAW

Covel Manufacturing Co., P. O. Box 116, Benton Harbor, Mich., has intro-



Excel Portable Power Metal Cutting Band Saw

duced the Excel Power Metal Cutting Band Saw in two models, stationary and portable. The portable model has two 8-inch diameter rubber ball bearing wheels which provide means for moving the saw to the job even over rough floors. As a retractable handle extends 12 inches, it is said to be easy to guide the saw into position. The stationary model has four pads with holes for hold down bolts. The saw

may be secured to the floor for heavy bar stock work

The fast-cutting, continuous metal cut-off machine with quick action vise. the company claims, makes it easy to change to different work sizes. The vise adjusts to cut any angle up to 45 degrees. The rollers are adjustable to stock size giving maximum support to the blade. Furnished complete with motor and drive. the machine is ready to operate. The machine has a capacity of 3 by 6 inches overall, 40 inches long and 12 inches wide. The blade is 1/2 inch wide, 0.020 inch thick and 60 inches long. The overall height at maximum capacity is 39 inches.

For more data circle 155 on Postpaid Card

FLY BAR

Lido Tools, 1972 Placentia, P. O. Box 403, Costa Mesa, Calif., has introduced a progressive step fly bar designed for fast, efficient stock removal by utilizing standard, low-cost lathe cutting tools. Radial steps designed into the rugged one-piece body of the heat treated body of the fly bar which takes four small chips instead of one



Ordering Information and Specifications on Ball Bearing Lathe Centers and Tailstock Spindles

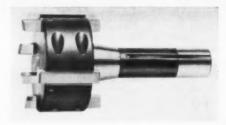
Just off the press...eight pages showing cut-away drawings, complete specifications, complete instructions on what and how to order... over 35 years of experience wrapped up in one catalogue, yours for the askingl Your request will receive prompt attention.

NIELSEN, INC. / LAWTON, MICHIGAN

For more data circle 544 on Postpaid Card

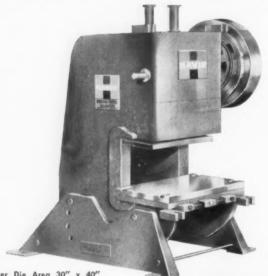
large chip, thereby eliminating vibration and excessive wear on machine spindles.

Setup time is said to be greatly reduced and standard tools are easily sharpened by the freehand method. Special blades are not required. Lido fly bars are available in two modelsa 40 National taper, No. 9 Brown &



View shows Lido Progressive Step Fly Bar

NEW 125 TON HAVIR OBI **SAVES YOU MONEY 8 WAYS!**



- Larger Die Area 30" x 40"
- Increased Die Life
- · Heavier, Normalized Welded Frame
- · More and Better Built Bearings
- · Airflex Clutch and Brake
- · Positive Safety Shutoff
- · Box-Type Flange Ram
- . Modern Design For Less Maintenance

Write for new catalog sheet giving full details. Havir has a full line of OBI's from 2 to 125 tons.

Havir Manufacturing Company

434 North Cleveland . St. Paul, Minnesota

For more data circle 545 on Postpaid Card

Sharpe, and an R-8 taper with 3/8 inch wide slots to accommodate tools.

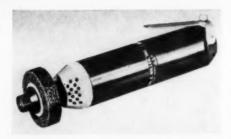
For more data circle 156 on Postpaid Card

m m s

SMALL-WHEEL GRINDERS

Small wheel grinders with governors, for developing maximum power at controlled speed on tough grinding jobs, have been added to the line of portable pneumatic tools made by Thomas C. Wilson, Inc., 21-11 44th Avenue. Long Island City 1. New York.

Wilson has added to its line of Series 921 grinders spindle and collet-chuck models with lever or pushbutton throttles and governed speeds of 12,000, 15,000, or 18,000 r.p.m.



Wilson Series 921 Small-Wheel Grinder

been added to the 31W series of nutrunners and screwdrivers by Buckeye Tools Corp., P. O. Box 966, Dayton 1, Ohio. The clutch engagement is controlled automatically rather than by the operator's own thrust. The latter method is standard in straight and pistol grip tools but is impractical for angle head models. The clutch is adjustable for any desired torque from 5 to 100 inch-pounds. Its jaws automatically disengage when the preset

For burring, die grinding and contouring. flash removal, snagging, weld smoothing, and similar operations, both models are available with a wide variety of adapters to accommodate small grinding wheels, rotary files, carbide burs, sanding and cutting discs, and so on.

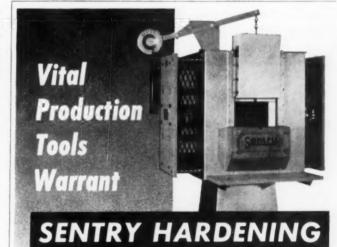
The Series 921 models with governors make possible the application of maximum power on jobs requiring small wheels and compact, lightweight tools.

For more data circle 157 on Postpaid Card

★ mms

RIGHT ANGLE TOOL

A fastening tool with a right angle head and a torque control clutch has



Correctly hardened tools are essential to high production. This is where Sentry Furnaces with the neutral Diamond Block Atmosphere fulfill their greatest need, offering reliable hardening without expensive supervision, and at, low, low investment and operating cost.

Your high speed tools achieve maximum hardness without risk of scale or decarburization, maintain sharp cutting edges longer, step up production.

For free demonstration hardening bring your tools to Booth 930 at the Detroit Metal Show.



ELECTRIC FURNACES

242-1

Request Catalog 2P • Write THE SENTRY CO., FOXBORO, MASS.
For more data circle 546 on Postpaid Card

torque is reached: re-engagement takes place when the lever throttle is released, momentarily shutting off the tool,

Carrying a rating of 1/4 machine screw, the tool is presently available in six models-1/4 inch square drive, 3/8 inch square drive, and 1/4 inch female hex at both 500 and 1300 r.p.m. speeds. Weight of the tools is less than 31/2 lb. and the length is under 121/2



View of Buckeye 31W Series Right Angle Tool

inches. The angle head design permits ready accessibility to difficult locations and minimizes torque reaction, Operation of the tool is said to be quiet at

all speeds, and rugged construction will withstand the wear of high production. For more data circle 158 on Postpaid Card

m m s

CORROSION RESISTANT ALLOYS

Universal-Cyclops Steel Corp., Bridgeville, Pa., has developed two straight chromium stainless steel alloys for the automotive industry which combines extremely high corrosion resistance with outstanding fabricating qualities and finishing qualities.

These grades, designated Unilov 430Mo and Uniloy 435Mo, derive their high corrosion resistance from an addition of molvbdenum to the stainless

Big 30HP "CHOP" Saw Ends UNDERPOWER Problems

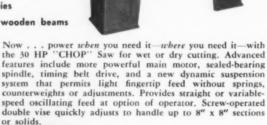
CUTS Steel structurals Bar stock Heavy cable Pipe

Test sections Forging blanks **Extrusion blanks** High temperature alloys

Rigging steel Fixtures and jigs

Cross ties

Heavy wooden beams





Write for FREE BROCHURE

TY-SA-MAN Machine Co., Inc. 1101 White Ave., Knoxville, Tenn.

For more data circle 547 on Postpaid Card

steel chemistry of Type 430. Uniloy 435Mo, in addition to the molybdenum, contains an element to control roping.

For more data circle 159 on Postpaid Card

* modern machine shop *

PUMP UNITS

Graymills Corp., 3769 N. Lincoln Ave., Chicago 13, Ill., has introduced

a series of pumps for circulating. agitating and dispensing moderate and light viscosity cutting oils. coolants. inks, paints, coatings and adhesives. Adaptable for direct mounting to 30 and 55 gallon drums, the extended column of the Series H55 makes it

nd 55 s, the olumn ries es it

Graymills Pump Unit

possible to pump off the bottom of the drum. The shaft is supported by heavy duty motor bearings and an additional guide bushing at the bottom to assure positive alignment and prevent whipping. Both models are powered by a ½ h.p. totally enclosed, explosion-proof electric or rotary air motors. Cover plates with mounting flange for open head drum are also available.

For more data circle 160 on Postpaid Card



For more data circle 548 on Postpaid Card

HAMMERS

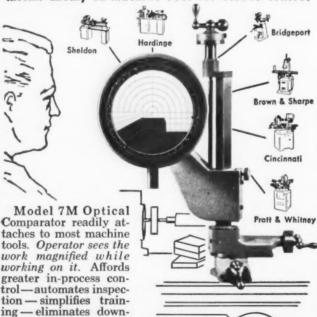
A line of soft faced hammers has been introduced by Armstrong Bros. Tool Co., 5228 West Armstrong Ave., Chicago 46, Ill. The hammers are designed to hold interchangeable nylon tips of varying degrees of hardness. The tips, which are color coded to indicate hardness, are resistant to oil,



View shows Armstrong Soft Faced Hammers

Optical Comparator

mounts directly on Machine Tool for Visual Control



Purchase, lease, or pay-out-ofsavings plans.

Special OEM engineering available.

Write for Catalog

No. 318A

STOCKER & YALE, INC.

STOCKER & YALE, INC.

time - reduces fatigue

-allows you to do work

you otherwise might not

be able to do.

For more data circle 549 on Postpaid Card

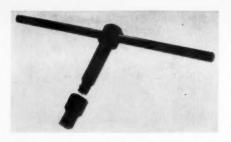
gasoline and common industrial acids. The soft faces prevent marring of finished surfaces and will not gash, mushroom or chip. The hammers are offered in three head diameter sizes-11/4, 13/8 and 13/4 inches and the replaceable tips are available in three grades of hardness.

For more data circle
161 on Postpaid Card

★ mms ★

HAND CHUCK

A line of hand chuck wrenches has been announced by PowerGrip, Inc., Rockfall, Conn. The distinctive feature of the wrenches is that with only two sizes of spinner wrenches (handle and assembled body) you can attach the proper



View shows PowerGrip Hand Chuck Wrenches

work stroke. The design is said to insure no loss of operating pressure during prolonged punching operations. Easily replaceable, heavy-duty suction filter protects all pump parts. The control valve design uses reversing motor for change of fluid flow—motor runs only when ram is moving.

Heavy duty contactors control motor direction with use of pushbuttons. Pushbutton enclosure can be mounted on punch, or used as pendant station.

socket to fit your chuck regardless of make. These sockets are quickly assembled or removed, as they are held in place by a spring ball. There are fifteen different sizes of sockets that can be assembled to the two handles. Special sockets and spinner wrenches can be furnished.

For more data circle 162 on Postpaid Card

★ mms

POWER UNIT

W. A. Whitney M fg. Co., 640 Race St., Rockford, Ill., has announced the No. 700 - T - ½ power unit, a companion for W. A. Whitney Portable Punches. The unit has two-stage pumping system for rapid approach, and slow down for



Flexible Shaft RECIPROCATING TOOL

Fast, precise, free from vibration, the Di-Profiler is indispensable for die, tool and mold making and finishing. The controlled stroke is variable from 0 to 1/4" and the speed is adjustable from 0 to 100 strokes per second. Impact of stroke is spring cushioned to reduce possible damage to work, tool or Di-Profiler.

Moderate in cost, the Di-Profiler pays for itself quickly through man-hours saved. Accessories for every type of job make this tool quickly adaptable for working any contour, detail, or finish.

Ask for a free demonstration or Catalog Sheet 'DS-101.

HYPREZ DIVISION

ENGIS EQUIPMENT COMPANY

431 South Dearborn Street, Chicago 5, III.

For more data circle 550 on Postpaid Card

Foot switches are also available. Low silhouette prevents tipping of power unit. A convenient carrying handle provides portability. The unit weighs approximately 59 lb. with oil, and is only 16½ inches long. The No. 700-T-½ power unit can be adapted for use with pressure switches, external adjustable relief valves, and pilot-



View shows Whitney 10 Ton Portable Punch with No. 700-T-1/2 Hydraulic Power Unit

Whether it's CHICKEN or CLAMPS Buy only the parts you want!







in ALL COMMON SIZES

double

Of course

CARR-LANE doesn't sell chicken parts, but we want to point up the fact that we, like a modern supermarket sell many clamp parts as well as complete clamp assemblies.

Each is a quality precision made item, rust proofed and at a price you couldn't duplicate in your own shop

INVESTIGATE TODAY!



double end



swivel heel



CLAMP ASSEMBLIES of all types

write or wire for Catalog



For more data circle 551 on Postpaid Card

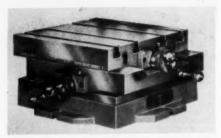
for Catalog

operated check valves. It provides for use with riveting guns, pinch off tools, positive holding of extended rams. The unit will operate both single and double acting cylinders. For more data circle 163 on Postpaid Card

mms

CROSS-SLIDE TABLE

Trovke Manufacturing Co., 11296 Orchard St., Cincinnati 41. Ohio, has announced the Model CS-12 cross-slide table for use in precision positioning on X and Y axis. The auxiliary table can be used in conjunction with standard rotary tables. mounting it above or below, to obtain X, Y and rotary motion. The Model CS-12



View of Troyke Model CS-12 Cross-Slide Table

PIERCING UNITS

Vogel Tool & Die Corp., 1823 North 32nd Ave., Stone Park, Ill., has introduced self-contained piercing units which provide a fast and economical means for piercing holes in straight or curved tubing, in flat stock, angle iron and other shapes according to the manufacturer. Known as Perf-Arc units, they provide both flexibility and adaptability to reduce setup time

has a 12 by 12 inch working surface, affords 10 inches of travel on each slide, and features hardened and ground acme feed screws mounted on tapered roller bearings and running in bronze nuts that are adjustable. Accuracy is said to be within 0.001 inch in the full 10 inches of crossslide travel.

Other features of the table include tapered gibs, adjustable quick-set dials accurately graduated in 0.001 inch increments, stainless steel scales graduated in 0.100 inch increments, gib locks on the crossslides, and stops on each crossslide for use with gage blocks or length gages. For more data circle



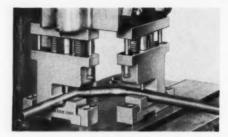
For more data circle 552 on Postpaid Card

164 on Postpaid Card

CORPORATION

as well as tooling cost. Perf-Arcs can be used singly or in gangs of two or more. When two or more, they can be mounted flush with each other, spaced apart, or at right angles.

The Perf-Arcs come in various sizes, some are for mounting in die sets only; others are for mounting on sub plate or directly to bolster plate, to



Two Perf-Arc units mounted at right angles to each other to accommodate bent tubing

NEW INFORMATION for every tool and diemaker The new edition of TOOL STEEL SIMPLIFIED gives you proved job-help found in no other book! . Put your toolroom on a profitable, competitive basis . Reduce heat treating failures . Improve tool and die performance . Lower diemaking costs . Take the guesswork from tool steel selection . Double check your tooling procedures . Train new men faster · Get more consistent results · Advance faster in your job . ORDER NOW! 23 chapters 596 pages PRICE ONLY \$2.50 349 illustrations (Postpaid in U.S.A. Elsewhere \$3) The Carpenter Steel Company, Reading, Pa. Dept. 3 Please send the NEW Tool Steel Simplified at low price of \$2.50 (\$3.00 outside U.S.A.) in full payment. Check or money order enclosed. Title Name. Company. Address Zone. State (please print)

function as self contained units. The bushings and perforators for each unit are available in a range of sizes and are made conveniently interchangeable. This arrangement is said to enable the Perf-Arc to be used economically on numerous types of jobs. For more data circle 165 on Postpaid Card

* mms

HINGED-STEEL CONVEYOR BELTING

A line of flattop, hinged-steel conveyor belting and flat-top belt conveyors has been announced by the May-Fran M a n u f a cturing Co., 1710 Clarkstone Rd., Cleveland 12, Ohio. The link design permits

construction of a flat, continuous loadsupporting conveyor surface for above floor or flush-with-floor installations. The end-curved, interlocking and overlapping steel belt links are precision formed to provide an almost smoothtop carrying surface. Through shafts, at each pitch, extend to join the side drive chains and position them. (Pitch is the distance between center lines of link through holes.) Intermediate connectors are used to fit over the through

shafts. These are attached to the underside of the belt, tying the entire assembly into an integral rigid unit that is easy to assemble and disassemble.

Conveyors can be designed to transport loads in one, or in two directions. One-Way Flat Top belting is nonreversible. Two-Way Flat Top belting is designed for reversible conveyor systems and will transport the load in either direction. The belting can negotiate convex or concave curves with safety. The hinged-steel interlocking belt design maintains closely fitted joints at all times. eliminating the operating safety hazards found with slat-type flat-top conveyors. Close belt

clearances prevent tools and assembly items from falling through.

The Flat-Top hinged-steel belting permits installation of above floor, or flush-with-floor conveyors. This design forms "a moving sidewalk," that can efficiently handle bulky, hot or heavy materials and assemblies. There are no stationary or moving parts that extend above the belt. This permits handling of materials and assemblies that are wider than the conveyor.

ARE YOU

WORKING OVERTIME TO KEEP YOUR PRODUCTION LINE FULL?

ARE YOU running more than one HACK OR BAND SAW?

Then you cannot afford to remain in the dark.

3 cuts - 6 finished ends.

Cuts shown took

only 58 seconds!

with

WALLACE "CUT-MACHINING."

YOU CAN

CHANGE MINUTES

Write! Learn how it's done.

WALLACE SUPPLIES MFG. CO. 1804 W. Cornelia Ave.

Chicago 13, Illinois

or Check Item 553



FOR PRECISION HOLDING POWER DAY-AFTER-DAY, YEAR-AFTER-YEAR YOU CAN DEPEND ON





Contour checking fixture with De-Sta-Co clamps provides a quick check of the accuracy of parts against a master template.



new equipment . . .



The May-Fran Hinged-Steel Conveyor Belting

Pallets of parts and packages can easily be picked up from the moving belt and unloaded where needed. Even while in motion, the Flat-Top conveyor permits a cross flow of foot or vehicle traffic without interrupting normal plant traffic flow. Flat-Top hinged-steel belt conveyors can be designed and supplied to virtually any practical width from 12 to 60 inches. The belts are available with 6 or 9 inch pitch links.

For more data circle 166 on Postpaid Card

* modern machine shop *

GEAR MOTORS AND BOXES

Spiroid Div., Illinois Tool Works, Inc., 2501 North Keeler Ave., Chicago 39, Ill., has made available subfrac-

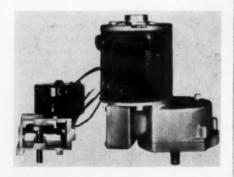


PRODUCTION

DETROIT STAMPING COMPANY

tional h.p. gear motors and gear boxes for original equipment with the Spiroid family of right angle reduction gears. Single, double and triple reductions can be made. Ratios are said to range from approximately 4:1 to over 100,000:1. Greater strength, size-forsize, and quieter operation is achieved by the use of Spiroid, Helicon or Planoid gear sets which, the company states, have more teeth in contact.

Substantial cost savings can be realized in quantities of 2,000 or more because of inherent manufacturing possibilities, such as rolling the pinions and sintering or molding the gears. Depending on the requirements. permanently sealed, conventionally closed, or skeleton units can be designed for each application. Low cost, precision machined housings are made from castings, extrusions and stampings. Typical applications for Spiroid packaged gear units are office machines, appliances, vending machines, and coin-operated record players. For more data circle 167 on Postpaid Card



Spiroid Gear Motors approximately (Left) 1/50 horsepower and (Right) 1/12 horsepower



FOR POSITIVE HOLDING OF COMPONENTS IN JIGS AND FIXTURES . . YOU CAN DEPEND ON





Simple drilling fixture made up of 5 toggle action clamps mounted on a plywood base holds drill bushing plate firmly in position.

FOR MORE FACTS
WRITE FOR NEW
TRACING TEMPLATES



IMPROVEMENT PRODUCTS

340 MIDLAND AVENUE

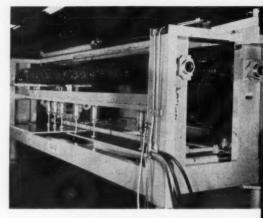
DETROIT 3, MICHIGAN

For more data circle 554 on Postpaid Card

PLATE CUTTING MACHINE

Wallace Supplies Mfg. Co., 1804 West Cornelia Ave., Chicago 13, Ill., has announced a plate cutting machine which is designed to cut both ferrous and non-ferrous metals. With the unit set up to cut non-ferrous metals the cutting head is locked into a fixed position and traversed with the width of the bed, at variable speed. The machine uses carbide tipped wheels. The company claims that aluminum plate 1 inch by 12 feet can be cut in under one minute and 4 inch aluminum plate cut at 4 feet or more per minute.

With the unit set for ferrous or steel alloys the head is unlocked to permit the abrasive wheel to "sense" its way through the cut as it oscillates in its alternating forward and reverse motion through the plate. According



View shows Wallace Plate Cutting Machine

to the company, 2 inch by 10 feet can be cut in a 12 minute maximum; larger size 26 inch diameter wheel unit can cut 4 inch stainless plate with 2 perfectly square straight edges in less than 24 minutes with no change in the

COMMANDER
TAPPER handles
"IMPOSSIBLE"
tapping job

THE JOB: Tap 4 6-32 holes 11/16" deep in the hubs of production run, heat treated gears.

THE PROBLEM: Excessive breakage of the specially relieved taps used to handle the unusual depth-to-diameter tapping job...spoiled parts...high

costs. A number of different tappers were tried, but the problem remained.

THE SOLUTION: A Commander Tapper was installed . . . adjustable torque control set to protect the tap and job was resumed.

THE RESULT: 1700 pieces were tapped without breaking a single tap. Tolerances were held and a very high rate of production was maintained. This is typical of the performance a Commander Tapper can produce.

The extreme sensitivity, and wide range of adaptability of a Commander Tapper can be put to work for you; ask your nearby Commander Distributor for a demonstration.

WRITE FOR PRODUCTION TOOL CATALOG TODAY!

Commander MFG. CO.
4224 WEST KINZIE STREET • CHICAGO 24, ILLINOIS

For more data circle 555 on Postpaid Card

metallurgical quality of the plate. The machine carries the cutting head on turned and ground round bars, fully enclosed in bellows type protectors.

The change-over from oscillating ferrous to fixed non-ferrous cutting can be made in a short time. The heavy frame eliminates deflection even under the weight of a full 2 inch by 12 foot wide plate of steel, according to the manufacturer. A mist coolant system is built in and feeds the mist onto the carbide cutting wheel automatically through the wheel guard when cutting non-ferrous metals. Air clamps must be engaged to move the unit.

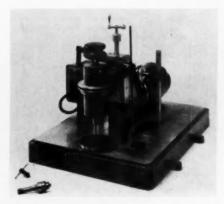
For more data circle 168 on Postpaid Card

* modern machine shop *

MICRO DRILL PRESS

F. W. Derbyshire, Inc., 265 Bear Hill Rd., Waltham 54, Mass., has announced a micro drill press for precision drilling of small, fine holes. The press has a throat depth of 4½ inches and the spindle, which slides in sleeves, has a travel of 1¼ inches. The column has a micrometer screw and can be adjusted two inches in thousandths of an inch.

Powered by a 1/12 h.p. motor, the



View shows Derbyshire Micro Drill Press

SAVE - MONEY - TIME - ENERGY



LEXCO HYDRAULIC LIFT TABLES

Capacities 500# to 2,000# STD. To 10,000# Special

Portable, adjustable height, Hand or Foot Operated. For lifting and transporting heavy castings, dies, etc., to machines and Presses.

Also DIE HANDLERS-STRIP STOCK HANDLERS

LEXCO ENGINEERING & MFG. CORP. 25 W. Chestnut St. Souderton, Pa.

For more data circle 556 on Postpaid Card

Get this Completely

PALMGREN Illustrated



FREE CATALOG #208

on Vises and Rotary Ta-

bles for Production, Tooling and Maintenance now. 70 different models and types—vise jaws from 1½" to 8".





PALMGREN PRODUCTS

8399 South Chicago Ave. • Chicago 17, Illinois For more data circle 557 on Postpaid Card

press takes standard Magnus-Elect collets in sizes from 0.004 to 0.315 inch. Special accuracy (0.0001 inch) collets can also be supplied. The Derbyshire Micro Drill Press has fingertouch control which, the company states, affords more sensitive drilling of small parts.

For more data circle 169 on Postpaid Card

★ modern machine shop ★

SUMP CLEANER

A compressed air operated industrial vacuum specially adapted to liquid "pick-up" jobs has been introduced by American Cleaning Equipment Corp., 5024 North Rose St., Schiller Park, Ill. The unit, Air Vac 701, utilizes up to 3 inch i.d. hose, cleans out sumps, pits and picks up "spills," and is said to take over 55



American Cleaning Air Vac 701 Sump Cleaner

gallons in 55 seconds. Having no electric motor or moving parts, the Air Vac can be used constantly without loss of time due to electrical maintenance. Special attachments are also available for dry cleaning of walls, broilers—and for reaching into hard-to-get-at areas. The Air Vac 701 also



effectively picks up steel or wood chips, sawdust, metal and can be highly useful in reclaiming valuable "waste" materials.

The Air Vac lid assembly is specially designed to permit shifting from full to empty drums in a matter of seconds. A mechanical shut-off stops the flow of liquid into the drum at the proper level. An Air Vac dolly equipped with large casters and retractable handle to hold and easily move drum and vacuum lid is also available.

For more data circle 170 on Postpaid Card

★ modern machine shop ★

TURRET HEAD

Logan Engineering Co., 4901 W. Lawrence Ave., Chicago 30, Ill., has announced the Mag Turret Head with eight station super air-lock turret which can convert any make or size standard engine lathe into a versatile



View shows Logan 8-Station Mag Turret Head

chucking machine. The Mag Turret Head is said to cut machining time, simplify difficult jobs, and speed up tooling.

The company states that the accurate and vibrationless turret replaces entire compound, eliminates tailstock and lessens operator fatigue and



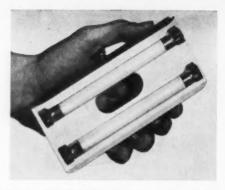
strain. The Mag Turret provides extremely rigid tool mounting and repeat indexing within 50 millionths of an inch. The design includes dovetail tool blocks with adjusting screw center tool. All moving parts are hardened, ground and chrome plated. For more data circle 171 on Postpaid Card

* modern machine shop *

MICROSCOPE ILLUMINATORS

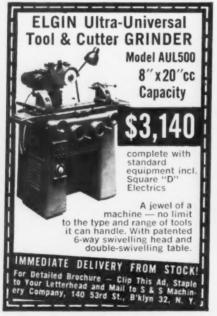
Special lights offered by Stocker & Yale, Inc., 250 Green St., Marblehead, Mass., are designed to mount directly on all leading microscopes. The objective of the microscope fits into the opening between the fluorescent tubes, which provide illumination that is a faithful reproduction of daylight.

The T4WM is one of many standard variations available. It uses daylight



Stocker & Yale T4WM Microscope Illuminator

fluorescent lamps which give a "flat" no-glare, shadowless light. The twin 4-watt miniature lamps deliver 500 foot/candles of cool, high-in ensity light, ideal for continuous inspection and laboratory observations. Stocker & Yale Microscope Illuminators light the full periphery of the subject being



For more data circle 560 on Postpaid Card
282 MODERN MACHINE SHOP



ANTON MACHINE WORKS

1226 FLUSHING AVE., BROOKLYN 37, N. Y.

For more data circle 561 on Postpaid Card October, 1961 viewed, completely immersing it in a bath of uniform light for positive visibility.

This low-cost lighting source is an outstanding inspection and production aid. It is said to help reduce operator fatigue and increase efficiency and output. If required. Stocker & Yale Microscope Illuminators can be supplied with a base and jackknife arm for use as side lights or sub-stage illuminators.

For more data circle 172 on Postpaid Card

modern machine shop *

THREAD CHASING TOOL

A tool holder, capable of chasing internal and external threads has been announced by C-H Industries, Box 125, Wallingford, Pa. The unit can be set up in any modern tool holder, and accepts external threading tool bits as well as internal boring tools. The tool holder has 0.210 inch travel in either direction with a beyond center lock, repeating within 0.0005 inch, which permits the threading tool to be quickly withdrawn from the work, without reversing the cross feed screw of the lathe.

The tool is said to appreciably increase production, eliminate possibilities of errors, and reduce screw wear. The tool may be obtained in-



View shows C-H "Flogaus" Threading Tool





VISE

Plain or Swivel Base



QUICK-CLAMP MIL-VISE

Jaw Width - 6" or 8" Jaw Opening - Unlimited

Write for detailed literature.

Nichols Morris Corp. 76-H Mamaroneck Ave.

White Plains, N. Y.

TOOLS

М

For more data circle 562 on Postpaid Card MODERN MACHINE SHOP 283

dividually or with a kit including six threading tools. An adapter is also available permitting use of the tool on any standard tool post. The company states thin wall tube cut off, chamfering, and grooving are also made easier with the "Flogaus" Threading Tool.

For more data circle 173 on Postpaid Card

POWER PRESS

Havir Manufacturing Co., 434 Cleveland Ave., St. Paul, Minn., has designed an all steel 25B, 25 ton automatic press to meet the needs of those wanting a versatile press to handle many types of long run stamping jobs. The 25 Ton Model is designed for fast, high production run blanking, punching, shearing, forming and piercing operations. It will handle small

to medium-weight jobs and is especially good for bulky jobs requiring large die areas. (The actual dimensions are 20 by 12% inches.) The press is available in expanded bed model with extra wide Auto Feeds.

Of straight-side design, the fourpost construction distributes ram force equally for continued accurate production of long runs. The key operating feature is the exclusive Havir Cylindrical Ram. It has maximum guiding surface which is said to insure accurate guiding of ram, punch and die. Thecompany states this feature, together with straight side construction, results in increased die life. Dies are further guarded

PROGRESSIVE LIDO CUTTING TOOLS

BORING TOOLS

Solid, head, high speed and carbide tipped boring tools (standard and stubby) featuring round shanks with parallel flats for solid, three-point clamping. Bore sizes from 1/16" to 1-1/4".



BORING HEAD

Rugged, precision construction featuring dial screw (guaranteed for life) graduated for direct reading, interchangeable shanks, two boring bar holes, plus cross-hole, choice of 3/8" or 1/2" bar holder.



FLY BAR

Progressive step fly bar takes four small chips instead of one large chip with low-cost standard lathe tools. Reduces spindle vibration and wear. Tools easily free-hand sharpened. Complete literature on request.

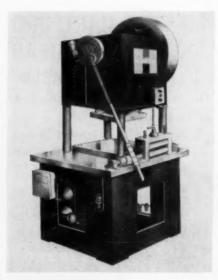




For more data circle 563 on Postpaid Card

with Havir's automatic shutoff. The press stops automatically in the event of a die-jam or misfeeding. Immediate automatic braking means one operator can safely attend several presses. The 25 ton auto-press is available with a Havir engineered single or double airclamped automatic feed, designed and built for this press alone. This gives the mechanism longer life and more precision operation, says the manufacturer. The standard model takes up to 81/4 inch stock widths. Air-clamped design prevents stock distortion and allows infinite controllable variations of roller pressure.

Another outstanding feature is Airflex drum-type clutch and spring applied brake. The air clutch assures positive engagement with flywheel through 360 degree friction surface for greater operating torque at any press speed. The press has standard operational speeds of 100 to 400 strokes per minute with slower or faster speeds also available. Other important features include modern design with fully enclosed crown,



Havir Model 25B, 25 Ton Automatic Press



NEW LINCOLN 225-AMP WELDER PERFECT FOR SMALL SHOP!

Here's a welder that can save time and earn dollars for you. With it you can do just about everything—weld mild and stainless steels, cast iron; braze; solder; thaw frozen pipes; hardsurface. Full 225-amp output lets you handle large 'w' electrodes, big jobs, fast. It helps you hustle work through your shop quickly and efficiently.

Only Lincoln makes this welder which sells for less than \$200 and which will burn \(^3\)_6" electrodes. Costs less than many 180-amp welders.

WANT DETAILS?

Send for new bulletin No. 4610.1. Describes machine and accessories, production and repair uses. Write today. The Lincoln Electric Company, Dept. 2441, Cleveland 17. Ohio.





The World's Largest Manufacturer of Arc Welding Equipment and Electrodes For more data circle 564 on Postpaid Card

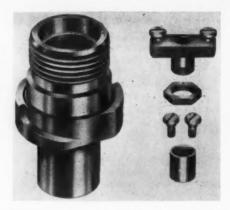
Vista Green color, one-shot metered lubricating system, heavy 570 pound flywheel and optional knockout bar. Crankshaft diameter at main bearing is $2\frac{3}{4}$ inches and at crankpin bearing is $3\frac{1}{2}$ inches.

For more data circle 174 on Postpaid Card

★ modern machine shop ★

DRILL BUSHING TIPS AND ACCESSORIES

Taper-Lok drill bushing tips and accessories manufactured by the American Drill Bushing Co., 5107 Pacific Blvd., Los Angeles 58, Calif., are said to provide a fast, accurate method for portable or stationary mounting of drilling, tapping and other self-contained machining units on a jig or fixture. The threaded end of the Taper-Lok bushing tip screws



Taper-Lok drill bushings and accessories

into the nosepiece of the drilling unit. The Taper-Lok flanges on the tip fit under the shoulders of lockscrews or lock strips on the jig, effectively holding the drilling unit in alignment position and absorbing both the thrust



For more data circle 565 on Postpaid Card

and torque of drilling. A thirty degree turn locks or unlocks the unit.

The tips are finished to A.S.A. specifications or can be manufactured to exact customer dimensional requirements. The Taper-Lok chip clearance prevents jam-up as the chips work back into the nosepiece and out the slots in the sides. The shanks are precision ground with entering bevels for easy insertion in lock liners. Like the shanks, the collars and threads

are heat treated to produce additional strength, provide wear resistance, and have concentric ground leads. Taper-Lok tips and parts are claimed to fit air tools, back spot facers, drills and tappers.

For more data circle 175 on Postpaid Card

FLEXIBLE CONNECTOR

Universal Metal Hose Co., 2133 South Kedzie Ave., Chicago 23, Ill., has introduced an allmetal bronze and carbon steel flexible connector. the "UC3," designated for conveyance of gases and fluids under temperatures up to 750 degrees F. Stainless steel versions are suitable for temperatures of 840 degrees F. and 1400



View shows Universal "UC3" All-Metal Bronze and Carbon Steel Flexible Connector

degrees F. The "UC3" connector features a braided outer cover and a corrugated inner tube for combined flexibility and extra strength.

For more data circle 176 on Postpaid Card



Some models have sides precision ground square with jaws for machining from 2 or 3 sides. Jaw widths 3", 4", 6" and 8" . . . from 3" to 9" openings.

CUT TOOLING COSTS UP TO 75%



Jia.

Use the HEINRICH Grip-Master Jig and Fixture Base. Simply add false jaws and bushing plate. Result . . . an accurate, low-cost Drill



Send for BIG, FREE 28-page catalog.

HEINRICH TOOLS, INC., DEPT. 111-J

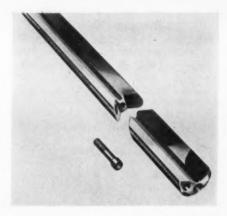
Racine, Wisconsin

For more data circle 566 on Postpaid Card

GUN DRILLS WITH QUICK-CHANGE DETACHABLE HEADS

Gun drills with quick-change detachable heads are now being marketed by National Twist Drill & Tool Co., Rochester, Mich. The detachable head feature is said to permit quick, easy replacement and convenient resharpening of the cutting head without removing the shank from the machine. This is particularly important on larger gun drills where one-piece head and shank construction makes resharpening an awkward operation. Tool inventories are also reduced, since a single shank accommodates several cutting heads.

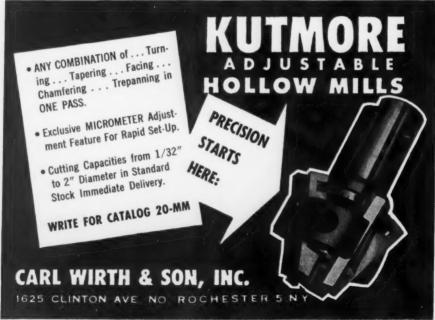
Quick-change cutting heads are securely joined to the shank in a veetype assembly by means of a socket



Gun drills with quick-change detachable heads

head cap screw. National Gun Drills with quick-change heads are available in Center-Cut as well as in the Target-Type design.

For more data circle 177 on Postpaid Card



For more data circle 567 on Postpaid Card

CENTERLESS GRINDER BLADES

O-Kni-Co Centerless Grinder Blades, made by the Ohio Knife Co., Dept. HH, Cincinnati 23, Ohio, provide efficient, precision grinding in the metalworking industry in straight production runs, as well as in job shops making short runs and frequent changes. For through-feed and infeed grinding on all types of centerless and double disc grinding, special O-Kni-Co

Grinder Blades are available in sizes and types for all work diameter ranges from 0.060 inch to 6 inches.

O-Kni-Co work rest blades are furnished with tips or inserts of tungsten, carbide or high speed steel. Carbide tipped blades are used by the majority of companies on straight production runs. Most materials can be ground on carbide tipped blades, and its long service life between regrinding makes them economical. High speed steel



For more data circle 568 on Postpaid Card

blades have many advantages, particularly for job shops of firms making frequent changes on short runs. They are said to be ideal for making alterations in contour, such as steps, grinding different diameters in the same piece, and in securing clearance for flanges, hubs, and the like.

In addition to standard through-



DRILL THESE HOLES

BY A QUICK, EASY, INEXPENSIVE METHOD Your business letterhead will bring literature.

WATTS BROS. TOOL WORKS Wilmerding, Pa.

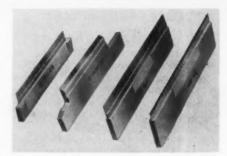
For more data circle 569 on Postpaid Card



#2 GEM Air Vise-Instantly adjustable to any

capacity up to 61/2".
\$120.00 delivered, guaranteed.
Also GEM AIR VISES from 3" to 12" capacity. Write for details.

J. E. MARTIN MACHINE CO. . SPRINGFIELD, OHIO For more data circle 570 on Postpaid Card



View of O-Kni-Co Centerless Grinder Blades

feed, and standard and roller infeed blades for maximum work lengths from 4 inches to 18 feet. O-Kni-Co Centerless Grinder Blades are also available for grinding small diameter work such as needle bearings, small drills-items that require small blades. The company also makes to specifications, many special blades such as step, contour, and plunge grinding blades. For more data circle 178 on Postpaid Card

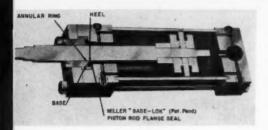
* modern machine shop *

ROD SEAL FOR CYLINDERS

The Miller Fluid Power Div., Flick-Reedy Corp., 7N015 York Rd., Bensenville, Ill., has announced that its self-adjusting, tamper-proof, pressureenergized flange rod seal for air and hydraulic cylinders has been improved with a "Base-Lok" design. An annular step at the i.d. of the bushing acts as a key to lock the base and heel of the



For more data circle 571 on Postpaid Card



Rod Seal for air and hydraulic cylinders

seal in proper relation to the rod. The base of the seal is said to be so securely locked into position that it becomes an effective bushing seal, eliminating need of a separate rod bushing seal and pressure balancing screen.

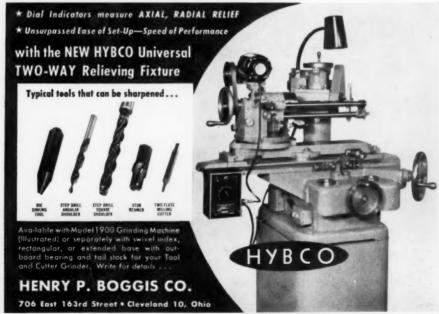
On hydraulic cylinders (except water hydraulic cylinders), the "Base-Lok" rod flange seal is Teflon to assure trouble free service with all hydraulic fluids including the special and fire-resistant types. On air cylinders and water hydraulic cylinders, the "Base-Lok" seal is synthetic rubber.

For more data circle 179 on Postpaid Card

* modern machine shop *

HORIZONTAL STACK-MICROHONING MACHINES

Greater accuracy, longer tool life and reduced cycle time are featured in the improved horizontal stack-Microhoning machines developed by Micromatic Hone Corp., 8100 Schoolcraft Ave., Detroit 4, Michigan. A technique recently developed by Micromatic, horizontal stack-Microhoning is used for finishing such parts as connecting rods and gears where the bore length is comparatively short with respect to bore diameter. The parts are stacked horizontally and Microhoned as "one long part." Advantages of this method is to include higher production rates,



For more data circle 572 on Postpaid Card





IT means better living for you

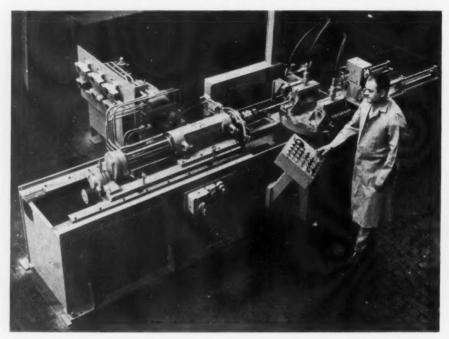
Once a manufacturer was looking for a better product. "I want to be sure that people NEED IT," he said. So he asked a lot of them about IT. The answers told him how to MAKE IT. Finally he GOT IT. But IT cost an awful lot to make. To sell it for less, he'd have to make IT by the million. Which meant IT had to be sold by the million, too.

So he let his advertising man SEE IT. Ads began to SHOW IT to millions who might LIKE IT enough to BUY IT. And they did. For IT was indeed a product that they needed, at a price they could afford to pay.

Then a big sign, MORE HELP WANTED appeared on the factory door. Everybody was happy, for now they had IT made.



Let's Keep Rolling Ahead



View shows Micromatic Hone Model 5HXH-16 Improved Horizontal Stack-Microhoning Machine

greater machine simplicity and reliability since only one spindle is used, and greater abrasive economy through the use of longer stones.

Micromatic's Machines, designated Model 5HXH-16, have a shorter, more rigid base which contributes to greater accuracy. The shorter base and a shorter tool put the work closer to the quill, thus making the tool more rigid. This minimizes the effect of tool sag and assures a straighter hole. Accuracy also is improved by the addition of a tool adapter which minimizes tool



For more data circle 573 on Postpaid Card

Spra - Kool
MIDGET
MIST-COOLANT
GENERATOR
\$995
Complete
GUARANTEED
PERFORMANCE
Order Sample or Write for Bulletin
BAR PRODUCTS CO.
4803 WHITE OAKS AVE. ROCKFORD, ILL.

For more data circle 574 on Postpaid Card

runout. An automatic hydraulic probe pre-checks for proper clearance in the bored holes. The probe is a safety feature that eliminates tool breakage and stone shear caused by improperly processed bores of parts that come to the Microhoning operation. Another feature is an integral shot-bolt locator for positive positioning of the indexing fixture.

An improvement in the coolant system, including larger distribution lines,

assures maximum coolant flow to facilitate removal of swarf from the work area. Another change has been the repositioning of the operator control panel for greater convenience and accessibility when changing tools. Collectively, the improvements are said to have also made possible a threefold increase in stone life., and a reduction in cycle time.

For more data circle 180 on Postpaid Card

* mms *

MACHINE

Important versatility in precision lapping of both large and small piece parts on a large volume production basis is now readily attainable with the development of the 36 inch

Gyro-Matic flat lapping machine produced by Spitfire Tool and Machine Co., 2931 North Pulaski Rd., Chicago 41, Ill. Available in both pneumatic lift and conventional models, the 36 inch unit may be purchased to meet individual production requirements. With a built-in capacity to obtain optical flatness to 1 light band (0.0000116), the 36 inch Spitfire Gyro-Matic often eliminates secondary steps in production, permits lapping and/or

Johnson

Speaks for itself in ANY SHOP!



Model J (Heavy-Duty) (Wet or Dry Models)

Johnson Model "J"... the heavy duty band saw that speaks for itself. No other saw handles so many operations so easily and so economically. Why pay more when a Johnson Model "J" can cut the 10" rounds, 18' flats and odd shaped steels of your shop in such labor saving time. The Big "J" is completely automatic—and is available in a wet or dry model, both with variable speed and centralized control system. You can't afford to miss any information on the rugged Johnson Model "J". Contact your dealer today!

MANUFACTURING CORPORATION
1011 BARNES ST., ALBION, MICHIGAN

Eastern Distributor
R. J. R. KELLY CO.
Hale Bldg., 51 Main St.
East Orange, N. J.

Midwestern Distributor
W. Q. LUNDMARK
75 N. Broadway
Des Plaines, Ill.

Western Distributor
HASTINGS DISTRIBUTORS
1605 Solano Avenue
Berkeley, Calif.

For more data circle 575 on Postpaid Card

SHORTCUTS to MARKING

by the Low Cost "point of contact" method that reduces waste.

Model 9
Pneumatic Marking Machine



A low cost marking machine powered by your regular air line 75 psi. and over. It marks parts, tools, sleeves, etc. of steel and also marks plastic with slight additional assembly. Write for Catalog No. 9.

PERIPHERAL MARKING MACHINE Model 9AH



Marks precision calibrations and graduations around dials. Uses flat dies to mark flats. A high production machine that will not break even brittle plastic parts. Write for Catalog. No. 9AH.

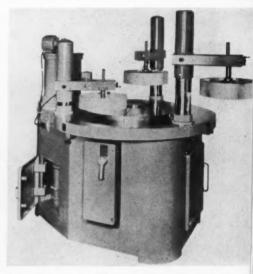
Ask ACROMARK® ENGINEERS which machines suit your marking need.

ACROMARK Ompany

9 Morrell St., Elizabeth, N. J.
"The Original Marking Specialists"

For more data circle 576 on Postpaid Card

new equipment . . .



Spitfire 36 Inch Flat Lapping Machine

finishing of piece parts directly from turning, milling, and sanding operations. The unit's abilities are said to easily permit automatic lapping and finishing of literally any materials; steel, cast iron, bronze, carbides, quartz.ceramics, and so on.

To assure ultra precise flat lapping, Spitfire has incorporated anti-distortion 36 inch lapping plate, a dry fluid drive which prevents shocks to parts, and a 3 point bearing contact between steel and work holder conditioning ring. This contact means rings revolve freely on lapping plate thereby maintaining plate flatness even as parts are lapped. Push button automatic operation, compact dimensions for such a large volume production machine (66 inch length by 60 inch height by 56 inch width) and the capability to accept either few large parts or many small parts regardless of size or shape, make this machine desirable in many industrial areas.

For more data circle 181 on Postpaid Card

BORING BARS

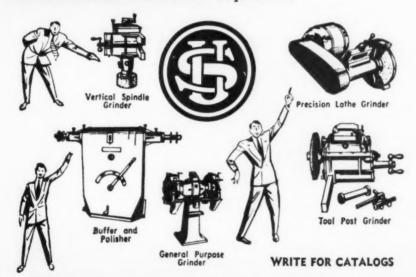
An innovation in boring cutter technology—adjustability with a graduated scale calibrated in increments of 0.0001 inch within a range of up to ½ inch—has been announced by Wesson Corp., 1220 Woodward Heights Blvd., Ferndale 20, Mich. The precision adjustment ring incorporating the calibrated scale is available in both standard and special Wesson Boring Tools. The illustration shows four styles of the bars. One style is a boring bar with inde-

pendent adjustments; one is coarse to adjust diameter in increments of 0.001 inch, the second is super precision for setting to 0.0001 inch. Total on the coarse adjustment is 0.250 on diameter and fine adjustment range is 0.004. Nominal hole size variation is from ½ to ½ inch by the use of interchangeable heads. Another style is a super precision boring bar with total adjustment range of 0.004 in 0.0001 inch increments. This boring bar is primarily for production jobs where the same hole size is to be bored to close

GRINDERS

BUFFERS

Now when quality performance and money-saving are of utmost importance—when cost-minded executives demand exacting vigilance, these tools fulfill every requirement.



Over 60 YEARS of Service to Industry

The United States Electrical Tool Co.
3640 LLEWELLYN ST., CINCINNATI 23, OHIO

For more data circle 577 on Postpaid Card

tolerance over long runs or repeated shorter runs.

A third style is a boring bar for super precision boring of any size hole in any kind of machine whether the bar is on centerline of the part or not. Adjustable in increments of 0.0001 over a range of 0.008 inch. Inter-

CENTERLESS GRINDING

Straight cylindrical, shoulder, profile and multiple diameter, internal and surface grinding of any material. Precision ground taper pins and straight dowel pins. Brown & Sharpe and Swiss Automatic aircraft and standard screw machine parts, heat treated and ground, if necessary. Light bench type production drilling. Prompt service. Send prints for estimates.

31 YEARS—SERVING INDUSTRY PORTER MACHINE CO., INC.

Mfgrs. of Por-Matic air operated drilling fixture. Drill bushings for same in stock. 3139 Enyart Ave. TR 1-4422 Cinti. 9, Ohio

For more data circle 578 on Postpaid Card

ADJUSTABLE DRILL JIG

- eliminates layout
- cuts drilling time

Used for drilling holes through round stock and hex stock from 1/4" to 2" and cap screws from 1/4" to stock from 1/4" to 2" and cap screws from 1/4" to 11/4", the new Mathewson Adjustable Drill Jig eliminates layout and can cut drilling time on small lots to a fraction. And it eliminates the costs of special jigs for larger quantities. . Holes for cotter pins, set screws, drive pins for bayonet joints, oil holes in tubu lar sections, and wiring holes in cap screws, are all typical of the operations that can be done more economically with this jig. Hole diameters range from .052" to .531", using your A.S.A. standard slip bushings. • The hardened V-block has two 60-degree V's for centering round or hexagonal stock, one for \(''\) to 21/32" diameter, one for 21/32" to 2" diameter. Adjustable stop for locating work longitudinally for drilling any distance from end, may be used on either side. Adjustable bushing carriers hold slip bushings and clamp work securely. • Jig highly successful in permitting use of inexperienced drill operators. For circular write to: Mathewson Machine Works, 40 liancock St., Quiney 71, Mass.



View shows four styles of Wesson Boring Bars

changeable heads permit use for hole sizes ranging from 1/2 inch up.

A fourth type of bar has both coarse and fine adjustment but uses throwaway inserts. Size variation, by use of interchangeable heads, is 1/2 inch to 3 inches. Lead angle, rake angle and insert style are variable. For more data circle 182 on Postpaid Card

modern machine shop *

METAL PROCESSING MACHINE

The VLW-83 Verti-Slide metalprocessing machine has been developed by The Torrington Manufacturing Co., Torrington, Conn., specifically for forming long wire and strip parts at feed lengths up to 24 inches and at



KELLER DIV.

Die Filers

3 LOW COST MODELS

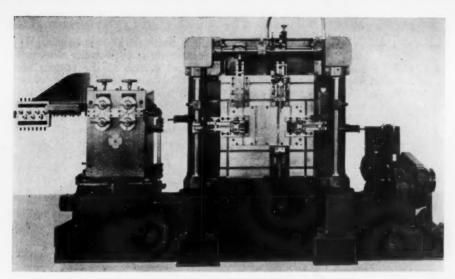
4 WAY TILTING TABLE . . . rugged, oilite bearings, balanced scotch yoke, 2 speeds, ECONOMY F256 — ONLY \$119.00. STANDARD F256A with file roller support arm, \$139.00. DELUXE F256B-with spring loaded slide and hardened jaws, \$159.00. All with 1/4-hp motor, F.O.B. Factory

Salex Service Mig. C

30 DAY TRIAL OFFER Satisfaction guaranteed or return in 30 days. Ask your

2361 University Ave., St. Paul 14A, Minn. Dealer or write. For more data circle 579 on Postpaid Card | For more data circle 580 on Postpaid Card

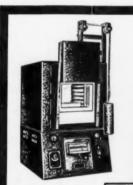
298 MODERN MACHINE SHOP October, 1961



VLW-83 Verti-Slide Metal-Processing Machine offers 24-inch feed length **Torrington**

speeds as high as 120 parts per minute. Modular design of the VLW-83 feed.

drive, press and forming units are said to provide unusual flexibility and ver-



Be sure of Maximum **Heat Treating Efficiency** with

HUPPERT FURNACES

- Range: 300° F. to 2000° F.
- High temperature, heavy-duty Kanthal elements
- Multi-insulation
- Counter-weighted, tight-sealing docr
- Operational pilot light
- Shipped ready to operate

Inside

Request literature on complete line of Huppert furnaces and ovens.

	Model No.	Dimensions				220 Volt Single Phase	
		Wide	High	Deep	KW	With Huppert Input Controller	With Electronic Temp. Controller
	869 11° 12° 12A°	8" 8" 8"	6" 6" 8" 8"	9" 12" 12" 18"	4 4 6 9	\$296.00 306.00 382.00 490.00	\$480.00 518.00 590.00 698.00

* For 2300° F. add \$95.00 to No. 11 and No. 12, and \$105.00 to No. 12A. No. 12A can be furnished for 3 phase at no additional cost. For floor model add \$52.00 to above prices. No. 869 standardly supplied for 2200° F.

K. H. HUPPERT CO.

Manufacturers of Electric Furnaces and Ovens

6841 Cottage Grove Ave., Chicago 37, Illinois

For more data circle 581 on Postpaid Card

satility in producing a wide range of precise metal shapes and forms. As many as eight interchangeable forming-slide units may be mounted at any desired position in the T-slots at the top, bottom and sides of the large tooling plate.

Maximum wire diameter in the VLW-83 Verti-Slide is 0.250 inch for limited bends, 0.207 inch for unlimited bends, and maximum strip width is

% inch. Standard slide strokes are 2½ inches at top (4 inch stroke also available) and 4 inch at the bottom and sides. Slide actuation may be either through box cams for high production or more economical plate cams with string or air return for short runs. The centerform may be adjusted over a lateral range of 24 inches in the 13% by 26%-inch toolplate, which is interchangeable for fast setup on repeat jobs. The multiple, adjustable rear motions have maximum stroke of ¾, 1½

"...it DOES make a Difference..."

More Shops Are Finding This Out

SPARTANIZED heat-treating gives a uniform hardness a bit different than others. This results in faster, straighter cutting and more cuts per blade.



write us for Bulletin "SAF-T"

Saf-T-Saws

These welded edge HIGH SPEED POWER BLADES are SHATTER-PROOF. Will stand extra tension and strain. They are doing outstanding jobs everywhere.

Teeth milled to exact size and shape, set evenly and accurately.

TRY THEM TODAY!

STOCKED FOR YOU BY DISTRIBUTORS



SAW WORKS, INC. SPRINGFIELD 7, MASS.

HACK SAWS . BAND SAWS . HACK SAW FRAMES HOLE SAWS . TOOL BITS . FLAT GROUND STEEL



For more data circle 582 on Postpaid Card

and $1\frac{1}{2}$ inches. In addition to adjustments along the wire line, the rear motions may be tilted within 10 degrees up or down to compensate for spring-back on right-angle bends.

* modern machine shop *

STANDARD UNIT TOOL ASSEMBLY FOR ROCKET CASES

In the manufacture of rocket cases a welding lathe is used and the peripheral weld must be finished. Standard Electrical Tool Co., Precision Spindle Div., 2487 River Rd., Cincinnati 4, Ohio, has developed a tool assembly of standard units to accomplish this and similar jobs. Turning, finish grinding and a cut-off operation may be performed, using the welding lathe setup. Standard Electrical Tool's "Solutioneering - Building Block" approach, gaining extra versatility from a standard machine, was used. The assembly, as shown in the



GRAYMILLS SUPERFLO COOLANT PUMPS and PUMPING SYSTEMS

Thousands of these popular GRAYMILLS bucket pumps are now in use. The Model SG1-4-25 gear type pump in a 5 gallon round container can be used to pump coolants and light oils. Easily installed in just a few minutes, it's used on single and double spindle drill presses, small lathes, hand screw machines and small spot welders. 1/25 HP motor delivers 1 GPM at a max. pressure of 22 PSI. You get top quality and top performance at a low price of only \$63. Buy it or other GRAYMILLS' pumping systems from your industrial distributor.

Write for complete catalog-No. 56R



GRAYMILLS CORPORATION

3769 N. LINCOLN AVE. . CHICAGO 13, ILLINOIS

Eastern Div.—1122 Hamilton St., Allentown, Pa. Western Div.—4312 W. Pico Blvd., Los Angeles 19, Calif.

DESIGNED AND PRICED FOR MACHINE BUILDERS USE

For more data circle 583 on Postpaid Card

October, 1961

MODERN MACHINE SHOP

301

Curved Tooth MULTIPLE CUTTERS



By using the wide range of Standard ABER CUTTERS for gang milling ... fast accurate cuts on any number of surfaces simultaneously.

ABER Engineering service will design and make the unit exactly suited to your job . . . send blueprints and specify material to be cut.

ABER Curved Tooth PLUS FEATURES

- 1. Longer production runs
- 2. More accurate control of limits and finish
- 3. Elimination of chatter
- 4. Faster heat dissipation
- 5. Shearing action

FREE DATA -

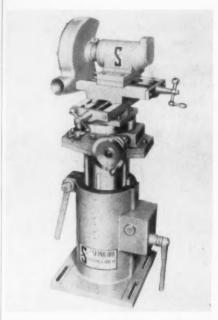
24 page catalog on milling with ABER Cutters.



ENGINEERING WORKS

FORD WISCONSIN

new equipment . . .



Standard Unit Tool Assembly for rocket cases

illustration, includes a motorized spindle and grinding wheel mounted on a compound feed and a 360 degree rotary table. To allow for center positioning, the tooling is mounted on a vertical lift column. The vertical lift column has a slotted base which may be attached to a floor leveling plate to



For more data circle 584 on Postpaid Card For more data circle 585 on Postpaid Card

302 MODERN MACHINE SHOP

October, 1961

allow remote positioning, if desired.

The composite assembly permits every conceivable movement. The motorized spindle may be replaced with a tool block and tools for turning or cut-off. The manufacturer points out that these elements, quickly and economically equip a basic machine for extra operations. The same and similar units may be selected for mounting on a machine designed for a special purpose.

For more data circle 184 on Postpaid Card

* modern machine shop *

SURFACE GRINDER

Norton Company, Worcester 6, Mass., has introduced the Norton TS Hand Surface Grinder in two sizes, 6 by 12 inches and 10 by 16 inches. The hand surface grinders were designed to meet the needs of toolrooms, die makers, school shops, repair shops, and so on, for a precision grinder at low cost. The hand surface grinder is made with the ruggedness and built-in precision features which are typical of the standard Norton hydraulically powered surface grinders. Ease of hand operation was a primary consideration in designing the hand surface grinder. Anti-friction bearings under the table take the effort out of hand traversing. An adjustable friction brake provides additional "drag" if desired.

The table traverse handwheel can be mounted on either side of the table



See Us—Booth 810—Detroit—Cobo Hall—Oct. 23-27 For more data circle 586 on Postpaid Card October, 1961 (perhaps you have a left-handed operator) and may be readily adjusted to position the handle for the most convenient short stroke operation. According to the company the two-speed grinding wheel downfeed hand wheel has graduations of 0.0005 inch for fast, accurate positioning, plus a finer control with a vernier which reads to 0.0001 inch. For fine feeding or finishing passes, there is a micrometer feed mechanism with reduction gearing that

IMPROVE PROFITS

Veet 3 foot
RADIAL

356000
F.O.B. Detroit
Quick Delivery

FOR TRUE RADIAL PERFORMANCE— GET A GENUINE RADIAL BY VEET

Finger-Tip Clutching Automatic Drill Ejector Push Button Elevation Centralized Controls Hardened Column & Way Inserts Automatic Depth Control Timken Bearing Column & Spindle Head Glides on Ball Bearing Rollers

Send for Brochure of Veet's 16 Points of superiority and name of nearest dealer for demonstration.

Mfrs. of the VEETMATIC Precision Drilling Machine with Numerical Control and the VEET SPEEDMILLER for Planer Conversion.

Tel Hammer 4-3888

For more data circle 587 on Postpaid Card

MODERN MACHINE SHOP

new equipment . . .

permits feeding in increments of 0.0001 inch. The 10 by 16 inch model has cross feed increments as small as 0.0005 inch. The 6 by 12 inch model has cross feed graduations in increments of 0.0001 inch. An adjustable friction brake also provides "drag" on the crossfeed.

Work height capacity under a fullsized grinding wheel is 12 inches on

You can't match VICTORY'S
Diamond Tool Prices







View shows Norton T-S Hand Surface Grinder

both models. Rigid and long vertical slides are said to insure accuracy throughout the full height range of workpieces. The saddle has a guide rail design, originally developed for the Norton hydraulic surface grinders, to give accurate crossfeeding throughout the life of the machine. The machine is capable of heavy, sustained usage. Heavy, ribbed construction of vital parts prevents distortion under load and any tendency of the wheel to "cock" under heavy feed. The antifriction bearing spindle is mounted in a cast housing which supports the spindle right to the end. The wheel guard is hinged for ease in changing wheels.

For more data circle 185 on Postpaid Card



SINE BARS

Tapped holes on working surfaces and edges for

clamping purposes, Side rails provided with each Sine Bar. 5'' sine bar size is $5\frac{3}{4}''$ x $\frac{3}{4}''$. Cylinders are alike . . . round and straight within \pm .00005, Axial accuracy within .00015, \$69.95 with plastic case.

(Cash with order unless rated in D & B)
SEVENTY-THREE MFG. CO. Gilbertsville, Pa

For more data circle 590 on Postpaid Card

& MANUFACTURING COMPANY

45 HARRISON STREET • NEW ROCHELLE N. Y.
For more data circle 589 on Postpaid Card

Type #302 stainless steel

machined with the Karlan cutter.

Write for Circular

broken tools made like new again

costs on any tool with a Morse Taper (sizes 1 to 6) Hundreds of leading industries save mor renmers countersinks cutters drivers the NU-TANG way. Prempt delivery. Send for prices-or send tools for repair, NO WELDING! NO SLEEVES!

d them to us like this!

NO DISTORTION! NO SHORTENING! GUARANTEED STRONG AS NEW!

We return then like this!

TANGS INC. 1331 Bates Avenue

Cincinnati 25, Ohio

For more data circle 591 on Postpaid Card

IMMEDIATE DELIVERY!







Cadmium plated, large selection of styles and sizes. Specials on request. Send for FREE catalog.

MACHINE PRODUCTS Corporation

For more data circle 592 on Postpaid Card

'S FOOL PROOF reading

New concept in Taper Tenths Plug Gages extremely Tool has no accurate readings even for amateurs. accurate diameter moving parts to slip and cause error, operator can read hole diameter quickly and accurately without removing gage . . . Available in sizes from 0.250 in. to 1.378 in. both stock and special units.

OLSON taper tenths PLUG GAGE 5000

OLSON INDUSTRIAL PRODUCTS, INC. 40 WEST WATER STREET, WAKEFIELD, MASS

For more data circle 593 on Postpaid Card



"FLYING CARPET"

"FLOATING AIR PLATFORM" FOR JIGS AND FIXTURES

FLOATS THE WORK ON A FRICTIONLESS FILM OF AIR

Put one or more, depending on size, under a Jig or Fixture, and the loaded unit, weighing 25 to 1000 pounds, can be moved with a finger. Your machine operator won't be so tired so will AUTOMATICALLY work faster when loading a lig or moving it from spindle to spindle. MORE PIECES ARE DONE PER HOUR. LESS WORK SPOILAGE, TOOLS line up with the bushings better, they don't chip, STAY SHARP LONGER. Comes ready to go to work, with valve, hose and fittings.

TRY ONE ON A 10-DAY, MONEY BACK GUARANTEE

PRICES: Model "A" 6" x 5%" x 1%" Model "B" 10" x 5%" x 1%"

The "Mighty Midget" Line

Makers of the "MIGHTY MIDGET" RADIUS & ANGLE DRESSERS.

SPERMAN METAL SPECIALTIES . 2199A E. 21st ST. . BROOKLYN 29, N.

For more data circle 594 on Postpaid Card

This new MORRISON KEYSEATER can make money for you

Install it in your shop. Its low cost will amaze you. Watch it pay for itself. You can quickly eliminate costly production tie-ups caused by waiting for expensive outside services. This is not an ordinary keyseater. The Morrison Keyseater is quality built with machine



tool accuracy. Proctically anyone can operate it. It has automatic feed, automatic stop to cut off feed at given depths, automatic relief to back the work away from cutters, automatic centering, automatic lubrica tion. NO BUSHINGS REQUIRED. Cuts keyways 1/16" to . FREE new Catalog 714-A shows all features and specifications can be had by writing:

THE D. C. MORRISON CO.

P.O. Box 1017-B Cincinnati 1, Ohio

For more data circle 595 on Postpaid Card



Compare Nirol Live Centers — see why more manufacturers specify Nirol:

- Extremely compact design
- Work expansion take-up automatically operated
- Easily accessible for lubrication
- Minimum overhang reduced vibration
- All working parts hardened and ground
- High radial and thrust load rating
- Interchangeable Bell heads. 60°, Female or special.

Many other exclusive features. Write for sizes, tapers and prices to:

MANUFACTURING CO.

901 Highway 22, No. Plainfield, N. J.

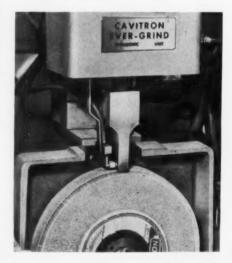
For more data circle 596 on Postpaid Card

new equipment . . .

UNIT TO PREVENT LOADING OF GRINDING WHEELS

An ultrasonic unit, designed to improve the performance and life of any grinding wheel has been produced by the Cavitron Equipment Corp., 51-02 21st St., Long Island City, N. Y. Known as the Cavitron Ever-Grind. the device is said to speed up production by reducing excessive loading on the wheel, thus cutting the need for frequent dressing and down time. Because it prevents build-up of particles in the open abrasive structure of the wheel, it permits the use of finer and harder grinding wheels. The result is a finer surface finish and greater dimensional accuracy, with a minimum of burning and work deterioration, even on difficult-to-grind metals.

The Ever-Grind uses a magnetostrictive transducer, driven by a generator operating on 60 cycle line current and converting it to vibrate the transducer at the rate of 20,000 cycles



Unit prevents loading of grinding wheels

another VICTOR value!

DIAMOND WHEEL DRESSERS

TOP QUALITY . LOWEST PRICES

Made of selected, full individual stones, mounted in 7/16'' diameter x 6'' long cold rolled shank.

Karat	Regular Price	Our New Price
1/4	\$ 6.00	\$ 2.85
1/2	12.00	5.00
3/4	21.00	7.50
1	30.00	10.25
1 1/2	54.00	15.00
2	75.00	20.00
21/2	102.00	26.00
3	130.00	32.00

These diamonds can be set in any shank to your specifications for \$1.00 each extra. Order Today -

Immediate Shipment from Stock!

VICTOR MACHINERY EXCHANGE, INC.

Tool Room Equipment Since 1918 DEPT. M. 251 CENTRE STREET

NEW YORK 13, N. Y. • TEL.: CAnal 6-5575

For more data circle 597 on Postpaid Card

Troubled by Withdrawal Marks?

the new RELIEVOMATIC* saves you costly refinishing!

No more rejects or refinishing because of marred surfaces made by cutting tools on their return pass! Now-the RELIEVO-MATIC renders precise parts with perfectly smooth surfaces. For boring, turning or facing on automatic metal turning equipment.

Write for complete technical literature.





*U 5 Patent No. 2,712,767

normal marred surface | perfectly clear surface with RELIEVOMATICE

SILBER PRODUCTS, INC. 870 ESSEX STREET . BROOKLYN 8, N. Y Nightingale 9 8600

For more data circle 598 on Postpaid Card

FREE SERVICE

for Readers of Modern Machine Shop

The Reader Service Cards between pages 32 and 33 and after page 324 can be used for obtaining free literature on any item appearing in this issue.

Simply look up the key number beneath the advertisement or editorial item and circle that number on the Reader Service Card. Print your name, address, etc. on the card and mail it to us. (We pay the postage.) We will forward your request to the proper company within 48 hours.

MODERN MACHINE SHOP cincinnati 2, ohio

new equipment . . .

a second. An aluminum tool, attached to the end of the transducer, is positioned close to the grinding surface of the wheel. As coolant is passed through the tool and on to the surface wheel, thousands of bursting bubbles (cavitation) are induced within the agitated fluid and "explode" against the grinding wheel as it rotates, simul-

taneously blasting away any build-up of metal particles and cooling the wheel. This highly effective cleaning and cooling technique is said to provide both increased grinding production and more efficient, economical, and higher quality grinding on an extensive range of materials.

For more data circle 186 on Postpaid Card

* modern machine shop *

RING TRANSFER PUNCHES



Made of hardened tool steel. Set includes 28 punches in increments of $\frac{1}{3}$ from $\frac{1}{3}$ 2" to $\frac{1}{2}$ 2" inclusive plus a $\frac{1}{3}$ 3." size. All punches are $\frac{4}{4}$ 4" long. Cadmium plated. .002 undersize. \$17.95. (Cash with order unless rated in D & B.)

SEVENTY-THREE MFG. CO. Gilbertsville, Pa

For more data circle 599 on Postpaid Card

KELM BLUEPRINT

Encourages orderliness and efficiency in your shop. Saves production time by providing convenient, close-at-hand reference or tools. Satisfaction guaranteed. Available in two models from \$19.75 to \$46.50. Fits all machines with universal mount. 18x24" of writing surface. Solid cast aluminum stand. Write for literature.



KELM MFG. CO. R. #2, Coloma, Michigan

MACHINE CLEANER

Cleans clogged T-slots
. . spoons out chips
and brushes them away.
Fastl Efficient!

Per dox.

Convenient design, heavy duty construction . . . reduces machine cleaning "down time". Thousands in use. Order from dealers or direct. Send for literature.

"Clean machines produce more and last longer"

KELM MFG. CO. R. #2, Coloma, Michigan

For more data circle 600 on Postpaid Card

HYDRAULIC MOTOR

The Acradrive 22 cubic inch hydraulic motor has been developed by the Cimtrol Div., The Cincinnati Milling Machine Co., Cincinnati 9, Ohio, for applications which require a control motor of extreme stiffness, high torque-to-inertia ratio, extremely fast response, and wide speed range with ultra-slow speed limits. Uses of the motor include positioning drives for machine tools, radar arrays, telescopes, processing machinery, and other specialized equipment which requires extreme precision and immediate servo response for orientation, location and speed.

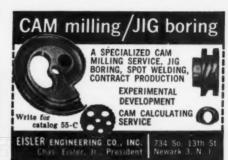
The Acradrive-22 servo motor operates at a recommended maximum pressure of 500 p.s.i., with an effective speed range under servo control of 1/60,000 r.p.m. to 500 r.p.m. The motor is said to deliver 3.52 inch lb./ p.s.i. torque at full capacity with an efficiency of 98 per cent, and reverses 100 r.p.m. rotation in 0.0015 seconds



For more data circle 601 on Postpaid Card



For more data circle 602 on Postpaid Card



For more data circle 603 on Postpaid Card

REDUCE Set-up Time and the need for expensive jigs & fixtures

Original HART Milling Fixtures
"Masters of A Thousand Set-ups"

Write for folder Value proved by years of use.
WALTER W. FIELD & SON, INC.
660 Arsenal St., Watertown 72, Mass.



For more data circle 604 on Postpaid Card



ZIEGLER FLOATING TOOL HOLDERS INCREASE TAPPING AND REAMING PRODUCTION

FAST SET-UPS — automatically compensates for misalignment up to $\frac{1}{16}$ " on dia. between machine spindle and work.

Free-Floating, Easy-To-Use Ziegler Tool Holders permit machine operators to maintain production without scrappage due to alignment inaccuracies, eliminate bell-mouthed and oversize holes and keep job set-up costs to barest minimum.

PROMPT DELIVERY

SIZES and types to fit all machines used for tapping and reaming.



Hold positive hole location tolerances



SEND FOR YOUR CATALOG TODAY

W.M. ZIEGLER TOOL C

13562 Auburn Detroit 23, Michigan

For more data circle 605 on Postpaid Card

new equipment . . .

and only 0.0006 of a revolution after the signal to reverse.

Eight radial pistons drive the motor through needle-bearing rollers acting on a two-lobed cam which encircles the hollow central spindle. The pistons are always under load; consequently, there is no backlash, even when the motor is reversed at high

Acradrive 22 cubic inch hydraulic motor

DRILL FEED UNITS



for drilling, tapping, milling, boring. Cam, hydraulic, or lead screw. Many sizes, ½ to 15 hp. Avey Division, Motch & Merryweather Cincinnati 1, Ohio

avey

or more data circle 606 on Postpaid Card



For more data circle 607 on Postpaid Card

speed. Because of its high torque-toinertia ratio and sensitive response even at lowest operating speeds, the motor may be connected directly to a leadscrew or driveshaft. The motor measures about 12 inches across by 6 inches thick, and weighs 138 lb. It has been applied to precision machine tools built by The Cincinnati Milling Machine Co., and is now available to other users.

For more data circle 187 on Postpaid Card

* modern machine shop *

HOLE SAWS

Nicholson File Co., Providence, R. I., has announced a complete line of carbon and high speed steel shatter-proof hole saws, taper adaptors and mandrels with high speed pilot drills.

REPRINT AVAILABLE

A limited number of copies of a reprint "Let's Discuss Numerical Control in Simple Language" are available. Quantities up to 25 copies are offered free of charge. Additional copies are available at a price of 10 cents each.

MODERN MACHINE SHOP

431 Main St., Cincinnati 2, Ohio

Best Advertising Buy in the Metalworking Field!

20

COMPARE COSTS! up to 50% lower!

12-time rates for the six top 7 x 10 metalworking publications range from \$600 to \$770. MODERN MACHINE SHOP gives you more in circulation, more in plant coverage . . . saves as much as 50%!

Only \$385 per page (12-time rate) lowest cost per thousand \$7.13.

COMPARE CIRCULATION! over 54,000 . . . over 36,000 plants . . .

The top six 7 x 10 metalworking publications have circulations ranging from 30,220 to 48,278. MODERN MACHINE SHOP delivers up to 14,000 more!

COMPARE RESULTS! 47.9% of inquiries are saleable!

In an analysis of MODERN MACHINE SHOP inquiries, 47.9% of the inquiries represented actual or potential sales. Over 70% of MODERN MACHINE SHOP circulation is verified direct with the reader.

SPECIAL OFFSET SECTION eliminates plate costs

Now MODERN MACHINE SHOP offers superb offset reproduction for your 7" x 10" ads, completely eliminating any plate or special art or production costs. All that is required is a clean black and white proof (one for each color) and a color proof. Your 7" x 10" ads can be adapted to full page or spread size.

Write for Complete Media Data File and SIC Circulation Analyses.

CIRCULATION BREAKDOWN BY STANDARD INDUSTRIAL CLASSIFICATION

(Based on Dec. 1960)

	(
19	Ordnance and Accessories	231
20	Food and Kindred Products	128
22	Textile Mill Products	143
25	Furniture and Fixtures—Metal	581
26	Paper and Allied Products	215
27	Printing, Publishing and Allied	
	Industries	77
28	Chemicals and Allied Products	351
29	Products of Petroleum and Coal.	121
30	Rubber and Misc. Plastic	
	Products	439
32	Stone, Clay and Glass Products	461
33	Primary Metal Industries	
34	Fabricated Metal Products	8,849
35	Machinery-Except Electrical 1	19,233
36	Electrical Machinery, Equipment	
	and Supplies	5,970
37	Transportation Equipment	6.180
38	Professional, Scientific and	
	Controlling Insts., Photographic	
	and Optical Goods. Watches and	
	Clocks	1.947
39	Miscellaneous Manufacturing	-1-11
00	Industries—Metal	1.098
40	Railroads	254
50	Wholesale Trade (Mill Supply	
00	Houses, Machinery Dealers, etc.)	2 145
82	Schools, Colleges, Libraries	593
11-21	Engineering and Scientific	000
14.51	Research Services	295
90	Government	223
30	Other SIC Groups	466
	Agencies-Exchanges-Samples and	400
	File	1 404
	TOTAL	
	IVINE	7,000

ADVERTISING BREAKDOWN BY PRODUCTS

January 1960 through December 1960

	PAGES	PERCENTAGE
MACHINE TOOLS	892	37%
MACHINE PARTS AND		
ACCESSORIES	572	24%
CUTTING TOOLS	431	18%
MISCELLANEOUS METAL-		
WORKING TOOLS AND		
ACCESSORIES	517	21%
TOTAL	.412	100%

modern machine shop

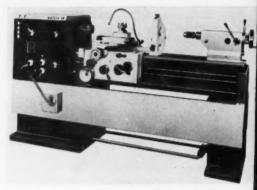
431 Main St. . Cincinnati 2, Ohio

Also publishers of PRODUCTS FINISHING and Products Finishing DIRECTORY

new equipment . . .



View shows Nicholson Shatterproof Hole Saw



View shows Alina "Mondiale" Engine Lathes

This line supplements the company's hacksaw and band saw blades.

For more data circle 188 on Postpaid Card

★ modern machine shop ★

ENGINE LATHES

Alina Corporation, 122 East Second St., Mineola, L. I., N. Y., has introduced "Mondiale," a line of precision engine lathes. There are five different models available.

Mondiale Lathes are precision-built for sustained accuracy and top efficiency. Mondiale features include ruggedness, economy, functional design, easy operation, standard spindle nose, hardened and ground ways, heavily ribbed bed.

For more data circle 189 on Postpaid Card

"ONE HOE FOR KALABO"

Sound and color 16 mm. movie film telling what machine tools are and what they do.

Culmination of several years of planning and production by the machine tool industry.

Designed primarily as a public education project.

Copy of film is available on free loan basis for showing to groups. Requests should be directed to Film Editor, Modern Machine Shop, 431 Main Street, Cincinnati 2, Ohio, and should specify the date of showing, the name of the organization requesting the film, the individual to whom the film should be addressed, address and telephone number.

MODERN MACHINE SHOP



...and your country! It's hidden in your Treasury Payroll Savings Plan. You benefit most when you actively promote this plan to your employees. It encourages both thrift and patriotism among your employees. It offers your company a hard-to-beat employee benefit program. It acts as an economic insurance policy for all Americans. Fill in the coupon now. Get some easy-to-use ideas for promoting this plan. They are simple. They are the result of long experience. They work. Act now!

Treasury Department U.S. Savings Bonds Divis We would like to promot our employees. Please s	e the Payroll Sa	vings Plan among
Name	Title	
Company		
Address		
City	Zone	State



U.S. SAVINGS BONDS

The U.S. Government does not pay for this advertisement. The Treasury Department thanks, for their patriotism, The Advertising Council and this Magazine.

WHERE TO GET IT



Abrasives, Grain, Cloth, Paper, Disc, etc., 16b, 16c, 39, 66, 67, 83, 98, between 100 and 101
Actuators, 14, 198
Adapters, 74, 175, 213
Additives, Cutting Oil, 214

Agitators, 206 Alloys, 50, 236, 263, 268 Arbors, 74, 86

Balancers, 15, 23 Bar Machines, Automatic, 180, 181 Bars, Boring, 28, 86, 256, 297 Bars, Sine, 304 Bases, Magnetic, 64 Bearings, Ball, 84, 85, 228 Bearings, Pilot and Support, 254 Bearings, Roller, 84, 85 Bearings, Thrust, 84, 85 Benches, Work, 204 Bits, Power, 12 Bits, Tool, 48b, 64, 300 Blades, Centerless Grinder, 289 Blocks, Setup, 70 Boring, Drilling and Milling Machines, Horizontal, 194 Boring, Drilling, Reaming and Tapping Machines, Combination,

Boring Machines, Inside Front Cover Boxes, Stacking, 204 Brakes, Press and Bending, 5, 24, 36, 220, 240, 246 Broaches, 64 Broaching Kits, 64 Buffing Machines, 297 Building Block Units, 251, 301 Burs, 89, 173 Bushings, Brass, Bronze, etc., 242 Bushings, Drill Jig, 14, 133, 213, 236, 286, 321

Boring Heads, 70, 74, 235, 284

Cabinets, 204 Calipers, 259 Carbides, 7, 50, 80, 163, 217 Carts, Stock, 204
Centers, Bench, 23
Centers, Index, 224
Centers, Lathe, Planer, Miller, etc., 157, 167, 239, 265, 306
Charts, Triogonometry, 103
Charts, Visual Aid, 244
Checking Instruments and Gages, 294
Chip Breakers, 246

Chisels, 177 Chucks, Air and Hydraulic, 86 Chucks, Automatic, 261

Chucks, Block, 185 Chucks, Boring, Inside Back Cover Chucks, Centering, Inside Back

Cover Chucks, Collet, 86, Inside Back Cover

Chucks, Diaphragm, 86, 221 Chucks, Drill, 42, 74, 75, 248, 261 Chucks, Grinder, Inside Back Cover Chucks, Indexing, 242

Chucks, Lathe, 248, Inside Back Cover Chucks, Magnetic, 91

Chucks, Power, 93, 315, Inside Back Cover

Chucks, Tap, 86 Chucks, Universal, 82, Inside Back Cover

Circulators, 206 Clamp Components, 272 Clamping Systems, 308 Clamps, 220, 233, 252, 272, 276, 277 Cleaners, Sump, 280 Clinching Machines, 33 Cold Heading Machines, 251 Collectors, Fume, 29

Collectors, Mist, 205
Collet Closers, 185
Collets, 74, 86, 185
Comparators, Front Cover, 97, 208, 222, 270

Connectors, 287 Control Systems, 53, 195, 216 Conveying Equipment, 274

Here they are—the **Buck** chucks that solve most work-holding problems



Left to right:

6 of the 15 types of Buck chucks.

- 1. Aluminum power chuck with gibbed keyways
- 2. Dust proof chuck
- 3. Steel Power chuck, Serrated Jaws
- 4. Independent chuck
- 5. Steel Power chuck, American Standard
- 6. 6 jaw Ajust-Tru

Ready to cut your machining costs

You start saving—on production or in the tool room—the day you put Buck Ajust-Tru chucks to work.

MANUAL chucks adjust for dead true precision in a minute—guarantee .0005" precision chucking duplicate parts.

POWER chucks—steel or aluminum body, regular or serrated jaws—guarantee precision within .001" and provide many other exclusive operating savings.

It's the unique, patented Buck Ajust-Tru principle that makes Buck chucks so different—at no price premium. It'll be well worth it to get full details.

NEW Catalog 61 ready-write for it.

BUCK TOOL COMPANY

1014 SCHIPPERS LANE . KALAMAZOO, MICH.

For more data circle 610 on Postpaid Card



Coolant Units and Systems, 224, 235, Coolants, 185 Counterbores, 163 Countersinks, 264 Covers, Protective, 189 Cranks, 264 Cubes, 257 Cut Off Machines, 71, 204, 230, 249, 255, 268, 275, 278 Cutters, Fly, 265, 284 Cutters, Gear, 9 Cutters, Inserted Blade and Tooth, Cutters, Milling, 9, 30, 48b, 163, 179, 247, 302, 304 Cutters, Tube, 177 Cylinders, Hydraulic and Pneumatic, 33, 86, 290 Diamond Wheels, 211 Diamonds and Diamond Tools, 50, 304 Die Filers, 298 Die Lifting and Handling Machines, 238, 279 Die Sets, 22 Die Sinking Machines, 55 Dies, Punching or Forming, 22, 62, 163 Dies, Threading, 8, 43, 48c, 178 Dividing Heads, 70, 220, 283 Dressers, Grinding Wheel, 223, 307 Dressing Fixtures, Grinding Wheel, 95, 215, 252, 254, 305, 310 Drill Blanks, 89 Drill Heads, 60, 61, 78, 96, 209, 288 Drill Jigs, 298 Drill Rod, 56 Drill Speeders, 273 Drilling Attachments, 74, 209 Drilling and Tapping Machines, Combination, 101 Drilling Machines, Automatic, 247 Drilling Machines, Bench, 17, 45, 279 Drilling Machines, Multiple Spindle, 209, 247, 250 Drilling Machines, Radial, 45, 158, 159, Drilling Machines, Turret, 17 Drilling Machines, Vertical, 48d Drilling Units, 60, 61 Drills, Center, Core, Twist, etc., 9, 48b. 86, 89, 109, 163, 178, 229, 233, 257, Drills, Portable Electric, 16b, 16c Drills, Portable Pneumatic, 16b, 16c

End Mills, 9, 48b, 89, between 132 and 133, 163, 205 Engraving Machines, 32, 55 Environmental Chambers, 197 Extensions, 175 Facing Heads, 70 Feed Units, 74, 216, 259, 310 Files, 173 Files, Rotary, 253 Filing Machines, 92 Filters, 48 Finishing Machines, 29 Flexible Shaft Equipment, 16b, 16c, 60, 61, 271 Fluids, Cutting, 273 Forming Machines, 46, 90, 240, 298, Furnaces, Heat Treating, 168, 245, 267, 299 Gage Blanks, 232 Gage Blocks, 319 Gages, Inside Front Cover, 8, 14, 16, 43, 48, 48c, 51, 59, 72, 163, 175, 178, 211, 243, 250, 263, 305 Gear Cutting Machines, Between 100 101 Gear Finishing Machines, 252 Generators, 294 Grinders, Abrasive Band and Belt, 194 Grinders, Center Type, 10, 11 Grinders, Centerless, 10, 11 Grinders, Chucking, 10, 11 Grinders, Cutter and Tool, Front Cover, 97, Between 100 and 101, 282, 291 Grinders, Die and Mold, 204 Grinders, Drill, 60, 61, 100, 242 Grinders, Face, 19 Grinders, Hand, 60, 61, 202, 204 Grinders, Hydraulic, 19, 226 Grinders, Lathe, 297 Grinders, Multiple, 197 Grinders, Portable Electric, 16b, 16c Grinders, Portable Pneumatic, 16b, 16c, 266 Grinders, Roll, 10, 11 Grinders, Surface, 22, 38, 40, 58 Between 100 and 101, 226, 303 Grinders, Tool Post, 60, 61, 297 Grinders, Universal, 52, Between 100 and 101, 236 Grinders, Valve, 16b, 16c Grinders, Vertical Spindle, 52, 297 Grinding Fixtures and Attachments, Front Cover, 22, 97, 291, 306 Grinding Heads, 25 Grinding Wheels, 50, 58, 66, 67, Between 100 and 101, 169

Dust Control Equipment, 29, 241

Drills, Square and Hexagon, 290

Duplicating Attachments, 74

Drivers, Tap, 175

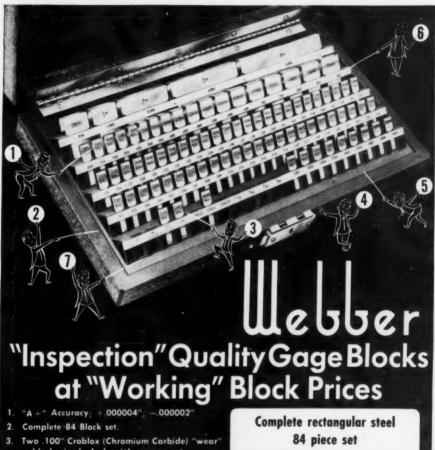
Hammer Molds, 256 Hammers, Hand, 173, 177, 270 Handles, Machine, 177, 264 Handwheels, 264, 305 Hardness Testing Devices, 174, 193. 262 Hinges, 230 Hobs, 9, 163 Hoist Hooks, 176 Holders, End Mill, 74 Holders, Floating, 86, 175 Holders, Magnetic Base, 234 Holders, Tap, 273 Holders, Tool, 70, 74, 175, 176, 234, 258, 269, 308, 309 Honing Machines, 87, 291 Indexing Heads, 286 Indexing Machines, 55 Indexing Units, 234 Indicators, 206, 232, 259, 308 Induction Heating Equipment, 10, 11 Instruments, Surface Measuring, 161, 184 Jaws, Chuck, 68 Jig and Fixture Components, 14, 305 Jig Borers, 233 Jigs and Fixtures, 22, 233 Keys, Machine, 222 Keys, Woodruff, 222, 227 Keyway Cutting Machines, 190, 244, 306 Knobs, Hand, 305 Lapping Machines, 49, Between 100 and 101, 295 Lathes, Automatic, 15 Lathes, Engine and Toolroom, 4, 15, 26, 34, 35, 63, 65, 79, 164a, 180, 181, 199, 248, 312 Lathes, Speed, 183 Lathes, Tracer, 65 Lathes, Vertical Turret, 31 Layout Materials, 224 Levers, 264, 305 Lighting Equipment, 282, 290 Liners, Bushing, 18 Lubricants, 186, 239, 255 Lubricators, 48 Magnets, Lifting, 221 Magnifiers, 203 Mandrels, Expanding, 86 Marking Devices, 62, 202, 217, 245, 296 Measuring Instruments, 70 Metallizing Equipment, 20, 21, 263 Meters, 175 Micrometers, 259 Microscopes, 47 Milling Attachments, 74 Milling Fixtures, 309

Milling Machine Attachments, 74 Milling Machines, Horizontal, 24, 88 Milling Machines, Turret, 74, 231 Milling Machines, Vertical, 24, 55, 88. Mills, Carbide, 253 Mills, Hollow, 288 Motors, 25, 276, 308 Mounted Wheels and Points, 323 Nibblers, 69, 244 Notching Units, 37 Nutrunners, Portable Electric, 16b. 16c Nutrunners, Portable Pneumatic, 16b, 16c Parts, Machine Tool, Production, Aircraft, etc., 14, 55 Perforating Units, 207 Pins, Dowel, Taper, etc., 192, 222, 227 Pins, Headed, 192 Plates, Angle, 260 Plates, Screw, 8 Plates, Sine, 14 Plates, Surface, 14 Pliers, 177 Polishers, Portable Electric, 16b, 16c Polishing Machines, 197, 219, 297 Power Units, Hydraulic and Pneumatic, 271 Presses, Arbor, 27, 222 Presses, Bench, 76 Presses, Hydraulic, 27, 76 Presses, Power, 16a, 44, 46, 214, 240, 266, 284, 289 Presses, Turret Punch, 57 Presses, Utility, 207 Profiling Machines, 55 Pullers, 177 Pumps, Booster, 224 Pumps, Coolant and Lubricant, 206, 269, 301 Pumps, Liquid Transfer, 269 Pumps, Molten Metal, 206 Punches, 177, 252, 308 Punching Units, 37, 273 Pyrometers, 309 Quills, 60, 61 Racks, Gear, 222 Ratchets, 113 Ratiomotors, 73 Reamers, 9, 89, 163, 237 Reductors, 73 Reels, 231, 237 Refractories, 66, 67, Between 100 and 101 Regulators, 48 Rests, Compound, Steady, Tool, etc., 264

0 0

Riveting Machines, 33, 218, 230 Rivets, 6 Rod Ends, 177 Rolling Machines, 90, 92 Routers, 89 Sanders, Portable Electric, 16b, 16c Sanders, Portable Pneumatic, 16b. 16c Sanding Machines, Belt and Disc, 228 Saw Blades, Band, 13, 16d, 99, 173, Saw Blades, Hack, 13, 173, 300 Saw Blades, Hole, 173, 300, 310 Saw Frames, Hack, 300 Sawing Machines, Band, 13, 16d, 92, 260, 264, 295 Sawing Machines, Circular, 268 Sawing Machines, Hack, 13, 213 Saws, Portable Electric, 16b, 16c Scrapers, Power and Hand, 77 Screwdrivers, Hand, 177 Screwdrivers, Portable Electric, 16b, 16c, 212 Screwdrivers, Portable Pneumatic, 16b, 16c, 212 Screw Machines, Automatic, 105 Screws, Cap, Set, Socket and Machine, 111, 248, Back Cover Screws, Transfer, 232, 258 Sealants, 200 Segments, Grinding, 58 Services: Milling, Grinding, Lapping, Rebuilding, Repairing, Business, etc., 232, 244, 256, 258, 282, 298, 304, 305, 309 Shapers, 24, 36, Between 100 and 101 Shearing Machine Attachments, 203 Shearing Machines, 24, 36, 241, 280, Shears, Bench, 280 Shears, Portable Electric, 219 Shelving, 191, 204 Shims, 41, 238 Sleeves, 281 Slotting Machines, 280 Sockets, 113, 176 Solenoids, 258 Spacers, 86 Special Machinery, 55, 224 Speed Reducers, 42 Spindles: Grinding, Boring, Milling, etc., 14, 25, 265, 324 Spring Winders, 212 Springs, 70, 218 Steel, Tool, 39, 274 Steel, Stainless, 39 Steel Stock, Ground Flat, 173, 300 Stops, Collet, 185, 232

Storage Units, 191 Studs, 248 Superfinishing Machines, 15 Surface Measuring Instruments, 161, 184 Swaging Machines, 223 Switches, 228 Tables, Elevating, 279 Tables, Machine, 272 Tables, Rotary and Index, 70, 74, 215, 224, 229, 256, 279 Tapes, Pressure Sensitive, 66, 67, Between 100 and 101 Tappers, Automatic, 209 Tapping Attachments, 42, 209, 273, 278 Tapping Heads, 209, 278 Tapping Machines, 48d, 78, 201 Tapping Units, 42, 60, 61, 78, 278 Taps, 8, 43, 48c, 163, 178, 250 Thread Rolling Heads, 240 Threading Machines, 15 Tool Control and Storage Units, 175 Tool Posts, 269 Tools, Boring, 28, 208, 254, 256, 284 Tools, Burnishing, 210 Tools, Carbide, 7, 9, 89, 163, 208 Tools, Chamfering, 264 Tools, Deburring, 220, 264 Tools, Facing, 208 Tools, Fastening, 12, 267 Tools, Flaring, 177 Tools, Nutrunning, 12 Tools, Recessing, 86, 182, 208 Tools, Reciprocating, 271 Tools, Relieving, 307 Tools, Screwdriving, 12 Tools, Special, 12 Tools, Threading, 165, 208, 283 Tools, Trepanning, 70 Tools, Turning, 254 Tracers, Lathe, 94 Transfer Processing Machines, Automatic, 55 Trucks, 204, 234 Tubing, Carbon, Alloy and Stainless Steel, 48a Turrets, Lathe, Tool Post, Bed and Tailstock, 281 Ultrasonic Machining Equipment, 251 Valves, 54, 164b, 216 Vises, Bench and Machine, 22, 70, 74, 81, 187, 218, 225, 243, 261, 279, 283, 287, 290 Welding Equipment and Supplies, 92, 262, 263, 285 Wrenches, 113, 177, 185, 270 Wrenches, Impact, 16b, 16c Wrenches, Torque, 238



- blocks included with every set.
- Beautiful rugged Melamine case frosted walnut grain finish. Piano hinge. Lock and key.
- Bakelite interior, easy to clean durable.
- Easy to read identification strips for instant selection of blocks desired
- Extra cavities provided for future additions.

New, highly efficient production equipment, designed and built by Webber "know how" and available only to Webber, makes possible volume production with resultant lower prices on these famous "inspection quality" gage blocks. They actually exceed the accuracies specified by the U. S. Bureau of Standards for grade "A" blocks.

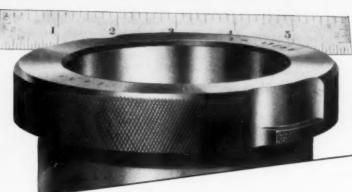
Ber Gage Company 12899 Triskett Rd. Cleveland 11, Ohio

CROBLOX® GAGE BLOCKS (made of Solid Sintered Chromium Carbide) pioneered by and produced exclusively in the Webber Laboratory

ADVERTISERS

IN THIS

A. K. Tool Co., Inc	Briney Mfg. Co
AMF Tool Div.,	Brookfield, Inc258
American Machine & Foundry Co 261	Brown & Sharpe Mfg. Co
Aaron Mchry, Co., Inc	Brush Instruments, Div. of Clevite Corp 161
Aber Engr. Wks., Inc	Buck Tool Co
Abrasive Products, Inc98	Bullard Co
Acme Industrial Co	Burgmaster Corp
Acromark Co	Burr & Son, John T244
Adjustable Clamp Co	Bystrom Co
Aget Mfg. Co	
Albertson & Co., Inc 16b, 16c	Cam Services Co
Alina Corp	Carborundum Co
Allen Mfg. Co	Card Div., S. W.,
Allison-Campbell Div.,	Union Twist Drill Co
American Chain & Cable Co	Carpenter Steel Co
Aloris Tool Co., Inc	Carr-Lane Mfg. Co
American Bechler Corp	Carroll Dividing Head Co
American Chain & Cable Co.,	Central Safety Equipment Co 189
Allison-Campbell Div	Cerro Sales Corp
Wilson Mechanical Instrument Div69, 193	Chicago Heights Steel Co
American Machine & Foundry Co.,	Chicago Mfg. & Dist. Co255
AMF Tool Div	Chicago Quadrill Co
	Chicago Rivet & Machine Co
American Saw & Mfg. Co	Cincinnati Gilbert Machine Tool Co 256
American Sealants Co., Inc 200	Cincinnati Milling Machine Co 10, 11
Anton Machine Wks	Cincinnati Milling Machine Co.,
Apex Machine & Tool Co	Cincinnati Milling Products Div169
Armstrong-Blum Mfg. Co	Cincinnati Shaper Co
Armstrong Bros. Tool Co	Clark Co., Robt. H
Atlas Press Co., Clausing Div	Clausing Div., Atlas Press Co82
Atrax Co	Cleereman Machine Tool Co 48d
Auto Moulding & Mfg. Co 230	Cleveland Instrument Co
Avey Div., Motch &	Cleveland Twist Drill Co
Merryweather Mchry. Co 247, 310	Commander Mfg. Co
Babcock & Wilcox Co	Comtor Co
Balcrank, Inc	Continental Machine Co
Bar Products Co	Cook Lead Hammer Service
Bausch & Lomb, Inc	Crane Packing Co
Bay State Tap & Die Co	Cullen Mfg. Co., Inc
Bearings, Inc	
Bellows-Valvair Corp	Dake Corp
Beverly Shear Mfg. Co	Dapra Corp
Black Drill Co	Davis Keyseater Co
Blanchard Machine Co	Delta Power Tool Div., Rockwell Mfg. Co 45
Boggis Co., H. P	Desmond-Stephan Mfg. Co 225
Borel & Dunner, Inc	Detroit Stamping Co
Boston Gear Wks	DeVlieg Microbore, Div. of
Bridgeport Machines, Inc	DeVlieg Machine Co28
Brightboy Industrial Div.,	Di-Acro Corp
Weldon Roberts Rubber Co 83	Diamond Supply Co. of America310



LARGE DIAMETER

ASA standard sizes up to 414" hole diame-ter. All renewable type bushings above the 7th diameter are provided with a double lock to insure more positive clamp-ing and longer bush-ing life.

BRINEY



BUSHINGS

Offer You the Most Comprehensive Line of LARGE DIAMETER, ASA STANDARD AND INSTRUMENT DRILL JIG BUSHINGS

BRINEY FREE LOCK BUSHINGS SLIP RENEWABLE BUSHINGS HEAD PRESS FIT BUSHINGS

and ground parts.

BRINEY ECCENTRIC LOCK BUSHINGS ROUND AND FLAT CLAMP BUSHINGS HEADLESS PRESS FIT BUSHINGS

Also an excellent source for locating pins, dowel pins and precision hardened

Contact any Leland-Gifford office

for catalog and price information



SMALL DIAMETER

Down to #80. All Briney Standard bushings including the smallest diameters are not counterbored. You get full bearing, full length for the drill or reamer. (Counterbored on request at no extra cost.)

Made By THE JIG BUSHING COMPANY, Pontiac, Michigan Stocked and Distributed By

WORCESTER 1, MASSACHUSETTS, U.S.A.

DISTRICT OFFICES

CHICAGO 5 2515 W. Paterson Ave. CLEVELAND 22 P. O. Box 853 DETROIT 21 10429 W. McNichols Rd.

2620 Leonis Blvd. Vernon 58, Cal. 75 S. Orange Av South Orange, P. O. Box 24, Charlotte Sta INDIANAPOLIS 6 P. O. Box 1051

For more data circle 611 on Postpaid Card

Diehl Mfg. Co	Laminated Shim Co., Inc
Dixie Bearings, Inc	Landis Tool Co
Dreis & Krump Mfg. Co	Lawley Granite Surface Plate Co 256
Dremel Mfg. Co	LeBlond Machine Tool Co., R. K 34, 35
Dugas Machine Wks., Inc	Leland-Gifford321
duMont Corp	Lennox Tool & Machine Builders303
Dumore Co	Lexco Engr. & Mfg. Corp279
Durant Tool Co	Lido Tools
Dykem Co	Lincoln Electric Co
Dynamic Chemical Co., Inc	Linley Bros. Co
Edroy Products Co	Lockformer Co
Eisler Engr. Co., Inc	Lodge & Shipley Co
Eldorado Tool Co	Logan Engr. Co
Empire Magnetics, Inc	
Enco Mfg. Co	M & H Products, Inc
Engis Equipment Co	Machine Products Corp
Erickson Tool Co	Magna-Lock, Inc
Ex-Cell-O Corp	Martin Machine Co., J. E
Field & Son, Inc., W. W	Mathewson Machine Wks., Inc
Field Tool Supply Co	Matthews & Co., Jas. H
Firth Sterling, Inc	McDonough Mfg. Co
Fiske Bros, Refining Co	Mead Specialties Co
Gallmeyer & Livingston Co 226, 227	Mechanical Tool & Engr. Co
Gammons-Hoaglund Co	Metallurgical Products Dept.,
Gatco Rotary Bushing Co	General Electric Co 50
Gisholt Machine Co	Metco, Inc
Gorton Machine Co., Geo	Mimik Tracers, Inc
Grant Mfg. & Machine Co	Minster Machine Co
Graphic Systems	Monarch Machine Tool Co 164a
Graymills Corp301	Monroe Engineering Products, Inc252
Greenerd Arbor Press Co	Morris Co., J. I
Grob, Inc	Morris Co., Robt. E
Gwilliam Co	Morrison Co., D. C
Hamilton Tool Co	Morton Machine Wks
Hammond Mchry. Builders, Inc 100	National Acme Co 165, 180, 181
Hannifin Co., Div. of	National Twist Drill & Tool Co 179
Parker-Hannifin Corp76, 164b	Nebel Machine Tool Corp63
Hardinge Brothers, Inc	Needham, Earl H
Harig Mfg. Co	Neise, Karl A
Hartford Special Mchry. Co 286	New Hermes Engraving Machine Corp32
Hauser Mfg. Co	Nichols-Morris Corp
Havir Mfg. Co	Nicholson File Co
Heald Machine Co Second Cover	Nielsen, Inc
Heimann Mfg. Co	Nielsen Tool & Die Co
Heinrich Tools, Inc	Nilson Machine Co., A. H
Hoggson & Pettis Mfg. Co	Nirol Mfg. Co
Holo-Krome Screw Corp Fourth Cover	Nobur Mfg. Co
Horton Machine Wks	Norton Co. 66, 67, Insert between 100 and 101
Huppert Co., K. H	Numberall Stamp & Tool Co
	Nu-Tangs, Inc
Ideal Industries, Inc	O. K. Tool Co., Inc
Index Machine Co	Olson Industrial Products, Inc
J & S Tool Co., Inc	Ottemiller Co., W. H
Jacobs Mfg. Co	Pacific Press & Shear Corp
Johnson Machine & Press Corp 289	Palmgren Products
Johnson Mfg. Corp	Pangborn Corp
Karlan Tool & Mfg. Co	Parker-Hannifin Corp
Kaufman Mfg. Co	Peerless Machine Co
Kelm Mfg. Co	Pemco Perforators Co
L & J Press Corp	Penniman, Elisha
L-W Chuck Co	Pipe Mchry, Co

Pope Mchry. Corp	25
Provide Disposed Tool Co.	11
Precision Diamond Tool Co	21
Punch Products Com	27
Punch Products Corp	27
Pyrometer Instrument Co	00
P.P. T. I. C. I. I. I. C. I. I. I. C. I.	20
R.B. Tool Co., Inc. 20 R-O Mfg. Co. First Cover, Strain Hydraulics & Mchry., Inc.	שט
R-O Mrg. Co	11
Reich Mfg. Co., J. R	10
Reich Mrg. Co., J. K	10
Beible Testing Machines Div	10
Reid Tool Supply Co	7 A
Ruthman Mchry. Co	74
Co. C. M. L. C.	20
S & S Mchry. Co	34
Savage Co., W. J	4 4
Schools Mr. Com	14
Schauer Mfg. Corp	53
Schupack Supply Co	22
Scully-Jones & Co	22
Seibert & Sons, Inc.	75
Sentry Co	57
Sentry Co. 26 Service Machine Co., Inc. 21	14
Seventy-Three Mfg. Co	18
Severance Tool Industries, Inc	13
Sheffield Corp	
Sheldon Machine Co., Inc	00
Silber Products, Inc	17
Sintercast Div., Chromalloy Corp 8	30
Skinner Precision Industries Inc.	3
Skinner Precision Industries, Inc	52
Somerset Tool Co	52
Somerset Tool Co	00
Spellman Co., R. L	52
Sperman Metal Specialties30)5
Sperman Metal Specialties	2
Standard Electrical Tool Co	14
Standard Steel Specialty Co	2
Standard Tool Co	3
Stevens Co., John B	4
Stocker & Yale, Inc	0
Sturdy Broaching Service, Inc 28	1
Sturtevant Co., P. A	8
Sundstrand Corp	
Sunnen Products Co	7
Supreme Products Corp	2
Sutton Tool Co Third Cove	er
Tapmatic Corp	3
Techni-Rite Electronics, Inc	2
Thermolyne Corp	8
Thomas Hoist Co	8
Thompson Grinder Co	0
Thompson & Son Co., H. G	d
Thriftmaster Products Corp	7
Titan Tool Supply Co., Inc	0
Torit Mfg. Co	3
Torrington Co	3
Torrington Co	5
irico rose mig. co	J

Troyke Mfg. Co	215
Ty-Sa-Man Machine Co	268
Union Twist Drill Co	. 9
U. S. Burke Machine Tool Div	31
U. S. Electrical Tool Co	97
Universal-Cyclops Steel Corp	39
Universal Engr. Co	13
Vascoloy-Ramet Corp	7
Vee-Arc Corp	67
Veet Industries	103
Vernon Devices	34
Victor Mchry. Exchange, Inc	107
Victory Diamond Tool Co	104
Vimco Mfg. Co	90
Vogel Tool & Die Corp	07
Wall Colmonoy Corp	
Wallace Supplies Mfg. Co	
Walls Sales Corp	
Wardwell Mig. Co	
Watts Bros. Tool Wks	
Webber Gage Co	
Wiedeke Co., Gustav	
Wiedemann Machine Co	
Williams & Co., J. H	
Wilson Mechanical Instrument Div69, 1	
Winter Bros. Co	
Wirth & Son, Inc., Carl	
Wisconsin Drill Head Co	
Ziegler Tool Co., W. M	

144 ABRASIVE WHEELS & POINTS



72 Abrasive Wheels & Points on 1/4 inch steel mandrels \$29.95 Complete In Handy, Sturdy Container At No Extra Cost If after 10 days you are not fully convinced that this is the greatest wheel and point value in the industry, return the set at no cost or obligation on your part.

Illustrated Free Catalog on Request

SCHUPACK SUPPLY CO. DEPT. MS-37
7331 Cettage Grove Ave. Chicage 19, Illinois
For more data circle 612 on Postpaid Card



Right Angle Attachment



No. 4208M



SUPER PRECISION

MILLING SPINDLES By STANDARD

No. 6026M Motorized, Liquid or Fan Cooled; with Feed



No. OOMY with Built-in Feed



No. 4403M Piggy-Back

Standard Super Precision Milling Spindles. The nation's widest line of conventional designs plus custom engineering service.

"endless versatile variations"
WRITE FOR CATALOG TODAY!



No. 4250M2Y Infinitely Variable 100 to 1000 R. P. M.



PRECISION SPINDLE DIVISION

the STANDARD electrical tool co.

2487 RIVER ROAD, CINCINNATI 4, OHIO

For more data circle 613 on Postpaid Card



Think Profit ...

HOLO-KROME THERMO-FORGED* SOCKET SCREWS HELP INCREASE PROFITS BY REDUCING INSPECTION REJECT AND IN-WARRANTY SERVICE COSTS

Join other profit-conscious industrial leaders in taking a long, hard look at the profit-eating costs of inspection rejects and in-warranty service. You'll see why they're turning to quality-in materials and components-to reduce costs and increase profit.

Holo-Krome's exclusive Thermo-Forged process produces socket screws of unmatched uniformity and quality . . . virtually free from flaws and hidden imperfections. Next time you order socket screws, think of final cost first. A few extra pennies spent on quality will save many hundreds of profit dollars by reducing the high cost of inferior fasteners.

Like full details on how Holo-Krome quality can help increase your profit? See your authorized Holo-Krome distributor, or write for more information.

IOLO-KROME Thermo-Forged*

THE HOLO-KROME SCREW CORPORATION . HARTFORD 10, CONN.

*Trade Mark of The Holo-Krome Screw Corporation

For more data circle 304 on Postpaid Card













modern machine shop

NOVEMBER 1961

MACHINE TOOL LEASING

See Page 114

HOW TO MACHINE THIN-WALLED PARTS See Page 122

The MAGAZINE for PRODUCTION EXECUTIVES in METALWORKING PLANTS



STANDARD for Spindles

To meet heavy demands for Super Precision Spindles, special space age tooling and other products, Standard Electrical Tool Company is now constructing the most modern machine tool plant in the country. Spindles for electrolytic grinding (above), milling, boring, drilling, etc., will be produced to millionths tolerances in this 100% climatically controlled plant for precision manufacturing (below).

See page 292.

THE STANDARD ELECTRICAL TOOL CO. . 2487 RIVER ROAD . CINCINNATI 4, OHIO